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Acceptance and the influencing factors towards intermittent self-catheterization among patients with neurogenic lower urinary tract dysfunction in China: a multi-centers cross-sectional study

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Competing interests

The authors declared no conflict of interest.

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The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics statements

Patient consent for publication

Consent obtained from parent(s)

Ethics approval

Approval was obtained from the Medical Ethics Committees of the Southern Medical University Shenzhen Hospital, with approval numbers NYSZYYEC20230031. All participants provided electronic informed consent and voluntarily completed the online survey. Additionally, all information obtained from the participants is strictly confidential and anonymized.

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Abstract

Objectives

The psychological acceptance of Intermittent Self-Catheterization (ISC) significantly impacts its initial adoption and long-term compliance among patients. However, our understanding of this acceptance remains limited. This study aims to investigate ISC's psychological acceptance and identify influencing factors among neurogenic lower urinary tract dysfunction (NLUTD) patients in China.

Design

A cross-sectional study design.

Participants

A total of 394 patients with NLUTD were recruited from 15 tertiary general hospitals in China.

Outcome measure

The patients completed a comprehensive questionnaire that included demographic and clinical characteristics, along with study instruments such as the Intermittent Catheterization Acceptance Test (I-CAT), the Intermittent Catheterization Satisfaction Questionnaire (InCaSaQ), the Intermittent Catheterization Difficulty Questionnaire (ICDQ), and the Intermittent Self-Catheterization Questionnaire (ISC-Q). Pearson's correlation analysis explored interrelationships among questionnaire scores, while Spearman's correlation assessed relationships between categorical independent variables and I-CAT scores. Additionally, multiple linear regression analysis identified key factors influencing psychological acceptance of ISC.

Results

Nearly half of the participants (46.5%) reported psychological challenges in accepting ISC, and more than 50% of the participants exhibited fear and low self-esteem in their I-CAT questionnaire scores. The I-CAT scores were strongly correlated with ISC training (r=0.861), ISC follow-up (r=0.766), and psychological well-being (r=-0.774). Regression analysis identified significant factors influencing ISC acceptance, including urinary tract infections, types of catheters, ISC training, ISC follow-up, and scores on the ISC-Q and InCaSaQ questionnaires, which collectively explained 82.5% of the variance in acceptance rates (F=193.687).

Conclusions

Psychological difficulties in accepting ISC are prevalent among NLUTD patients. Key facilitators of ISC acceptance include receiving ISC training, ISC follow-up support, and favorable ISC-Q

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scores. In contrast, barriers such as experiencing more than two urinary tract infections annually and the use of non-hydrophilic catheters pose significant challenges. This study recommends implementing strategies to enhance positive influences and mitigate negative impacts to improve ISC acceptance.

Keywords: Neurogenic lower urinary tract dysfunction; Intermittent self-catheterization; Psychological acceptance; Influencing factors.

Strengths and limitations of this study

- This study represents the first comprehensive evaluation of the psychological acceptance of ISC among patients with NLUTD. It innovatively incorporates sociodemographic, clinical, and psychological variables, offering significant insights for the development of health education and intervention strategies in clinical practice.
- This study is the first to quantitatively assess patients' experiences with ISC using the InCaSaQ, ICDQ, ISC-Q, and I-CAT instruments. It investigates the relationships between ISC satisfaction, difficulty, and related quality of life and the psychological acceptance of ISC. This approach provides comprehensive data support and reveals critical factors influencing patients' psychological acceptance, offering valuable evidence for optimizing clinical intervention strategies.
- This study included patients from 15 tertiary hospitals across five provinces, ensuring both the diversity and representativeness of the sample.
- As a cross-sectional study, this research identified potential factors influencing patients' psychological acceptance of ISC. However, the absence of time-series data prevents the establishment of causal relationships. Future research should employ a longitudinal design to gain deeper insights.
- Although this study used well-validated assessment tools (such as I-CAT, InCaSaQ, ICDQ, and ISC-Q) to capture patients' experiences and perceptions, self-reported data may be subject to recall bias and social desirability bias.
- Since the sample was drawn only from tertiary hospitals, excluding patients from secondary or primary hospitals, this might have led to an underestimation of the psychological difficulties faced by patients in accepting ISC.

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1.INTRODUCTION

Neurogenic Lower Urinary Tract Dysfunction (NLUTD) is a condition characterized by bladder or urethral dysfunction due to neurological disorders, commonly found in patients with spinal cord injury, stroke, Parkinson's disease, and multiple sclerosis[1]. These conditions disrupt neural transmission, leading to uncoordinated bladder and urethral function, resulting in urinary retention, incontinence, urinary tract infections, and upper urinary tract damage[1, 2]. NLUTD not only causes severe physiological symptoms but also significantly impacts patients' mental health and social life, while increasing the economic burden on healthcare systems [3].

Since Lapides introduced ISC in 1972, ISC has become the standard treatment for NLUTD [4,5]. ISC enables patients to void independently, reducing the risks of urinary tract infections and kidney damage, and thereby significantly enhancing their quality of life[5]. Despite the well-documented clinical efficacy and technical advantages of ISC, its global implementation and adherence rates remain below expectations[6]. For instance, in China, the implementation rate is only 26%[7]. This indicates a substantial gap between guideline recommendations and actual clinical practice. The psychological acceptance of ISC by patients significantly influences its adoption and sustained adherence [8], which is crucial for successful ISC implementation [9]. However, there is limited knowledge about the factors affecting psychological acceptance of ISC. Current qualitative studies suggest that procedural complexity, difficulty, negative emotions such as fear and embarrassment, and low satisfaction with ISC devices may impact patients' acceptance and adherence [8,10–13].

Therefore, this study aims to conduct a cross-sectional, multicenter survey to comprehensively quantify patients' psychological acceptance of ISC and explore its influencing factors. Special focus will be placed on ISC satisfaction, operational difficulty, and their relationship with the quality of life. This research seeks to fill existing gaps, providing scientific evidence to improve the psychological acceptance of ISC in clinical practice. It will aid in the development of more effective clinical guidelines and policies, increase ISC implementation and adherence rates, and ultimately enhance patients' quality of life.

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2.METHODS

2.1 Study design

This study was conducted from March to September 2023 across 15 tertiary general hospitals in five provinces of China. These hospitals are acknowledged as critical centers for healthcare, education, and research, each with a minimum of 500 beds[14]. A convenience sampling and cross-sectional study design were employed.

2.2 Participants

Participants were included based on the following criteria: (1) aged between 18 and 65 years; (2) diagnosed with NLUTD resulting from central nervous system injuries, such as spinal cord injury, multiple sclerosis, stroke, spina bifida, or Parkinson's disease; (3) prior or current practice of ISC. The exclusion criteria were: (1) cognitive impairments, visual impairments, or hand function impairments; (2) other comorbidities, including urethral stricture, bladder or kidney stones, or rectal dysfunction. To improve the quality and transparency of the research, the team employed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement checklist (See Appendix 1).

2.3 Data collection procedure

The online survey was conducted using the widely recognized platform "Questionnaire Star". Initially, consent was obtained from incontinence specialist nurses at tertiary hospitals in Guangdong, Henan, Hubei, Sichuan, and Anhui provinces. After the questionnaire was designed, it was uploaded to the "Questionnaire Star" platform, and a link was created. Before distributing the questionnaire, online training was provided to incontinence specialist nurse investigators at each participating center. Investigators were considered qualified after they could explain each item in detail to the main researchers. Subsequently, the link was shared with the incontinence specialist nurses at each center, with a request for 25-30 patients to complete the survey. Each participant had the right to decide whether to participate and could withdraw from the study at any time. Before presenting the questionnaire content, a page outlining the study's objectives, methods, and ethical considerations was shown to obtain informed consent. If participants provided informed consent, they could proceed to complete the questionnaire. To maintain survey

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integrity, all questions had to be answered, and each respondent's IP address was allowed to submit the questionnaire only once. Upon approval by the research team, patients received a compensation of 20 RMB (approximately 2.5 Euros). The sample screening process is shown in Appendix 2.

2.4 Sampling

The sample size was calculated by multiplying the total number of independent variables, which include demographic and clinical characteristics as well as the quantity of scales, by 15, yielding a total of 300 (N = [14 + 3] * 15 = 255). Considering a 20% potential nonresponse rate, the final required sample size was accordingly adjusted to 318.

2.5 Outcome measures

2.5.1The Intermittent Catheterization Acceptance Test (I-CAT)

The I-CAT was designed to assess individuals' psychological acceptance of practicing ISC and was developed by Guinet-Lacoste et al in 2016[15].This scale contains 14 items and consists of three dimensions, including multiple fears, self-esteem and global question. The items are scored from 0 (strongly disagree) to 4 (strongly agree). A higher score on the I-CAT signifies a lower level of psychological acceptance of ISC. The Chinese version of I-CAT was utilized in this study, demonstrating good reliability and validity[16]. In this study, the Cronbach's alpha coefficient was 0.946.

2.6 Influencing factors

The questionnaire comprised two sections: demographic and clinical characteristics, and study instruments, such as the InCaSaQ[17], the ICDQ[18], and the ISC-Q[19].

2.6.1 Demographic and clinical characteristics of patients

The participants' demographic and clinical characteristics included information on age, gender, marital status, occupation, family residence, personal monthly income, education level, medical expenses payment method, residential living arrangements, duration of performing ISC, urinary tract infections, types of catheters, ISC training (whether they received knowledge and skills

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training on ISC during hospitalization), and ISC follow-up (whether they received post-discharge hospital support for ISC).

2.6.2 Study instrument

(1) The Intermittent Catheterization Satisfaction Questionnaire (InCaSaQ)

The InCaSaQ for assessing patient satisfaction with ISC, developed by Guinet-Lacoste et al in 2014[17].This scale contains 8 items and consists of four dimensions, including packaging, lubrication, catheter itself and after catheterization. The items are scored from 0 (extremely dissatisfied) to 3 (extremely satisfied). A higher total score on the InCaSaQ indicates greater satisfaction of ISC. In this research, the Cronbach's alpha coefficient registered at 0.895.

(2) The Intermittent Catheterization Difficulty Questionnaire (ICDQ)

The ICDQ was designed to evaluate the challenges patients face when performing ISC and was developed by Guinet-Lacoste et al in 2014[18].This scale 13 items contains two categories, including frequency and intensity. The instrument explicitly describes the ease of catheter insertion and withdrawal, the presence of pain, limb spasticity, urethral sphincter spasms, and local urethral bleeding during catheterization. The ICDQ employs a four-point Likert-type scale, with scores ranging from 0 ("None" for intensity or "Never" for frequency) to 3 ("Considerable" for intensity or "Always" for frequency). A higher overall score on the ICDQ indicates greater difficulty. Within this study, the Cronbach's alpha was measured at 0.943.

(3) The Intermittent Self-Catheterization Questionnaire (ISC-Q)

The ISC-Q was meticulously developed by Binny Pinder and colleagues in 2012[19]. Designed for completion by ISC patients, the questionnaire aims to evaluate the quality of life related to their unique needs, encompassing both physical and psychological concerns. This scale contains 24 items and consists of four dimensions, including ease of use, convenience, discreetness, and psychological Well-being. A 5-point Likert scale, ranging from 0 (strongly disagree) to 4 (strongly agree), is employed. After converting responses from 14 reverse-coded items, scores are calculated by averaging the items within each dimension and then multiplying by 25, yielding a universal range of 0-100. The overall ISC-Q score is derived from the mean values across the

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four dimensions, with a higher ISC-Q score indicating a more favorable QOL in relation to ISC. In this study, the the Cronbach's alpha was 0.821.

2.7 Ethics statement

Approval was obtained from the Medical Ethics Committees of ***, with approval numbers ***. All participants provided electronic informed consent and voluntarily completed the online survey. Additionally, all information obtained from the participants is strictly confidential and anonymized.

2.8 Patient and Public Involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

2.9 Data analysis

Statistical Package for Social Sciences (SPSS 26.0 for Windows) was used to conduct data analyses. Descriptive statistics such as means, standard deviations (SD), and frequencies were used to examine the main characteristics. Spearman's analysis is used to examine the relationship between categorical independent variables and continuous dependent variables, while Pearson's analysis evaluates the relationship between continuous independent variables and continuous dependent variables.Demographic and clinical characteristics, InCaSaQ, ICDQ, and ISC-Q were included in a multivariate linear analysis to identify the main factors influencing ISC psychological acceptance. These models were created using a backward selection method. Significance for all statistical tests was set at 0.05 (2-tailed).The categorical independent variables were recoded (assignment) before stepwise linear regression analysis (See Appendix_3).The variance inflation factor (VIF) was used to assess multicollinearity among the predictors.

3. RESULTS

3.1 Participant characteristics

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Out of 394 participants selected based on the inclusion criteria, 327 completed the validity questionnaires. The overall response rate of 82.99%. Table 1 shows the demographic and clinical characteristics of the respondents. A majority of the respondents (72.2%) were aged between 18 and 45 years. Over half of the participants were male (59.0%). Approximately 60.6% of the patients were married. Half of the patients were unemployed (51.4%) and hailed from rural areas (52.3%). A significant portion, exceeding half, reported a monthly income below 3000 yuan (83.8%). Approximately 55.0% of the respondents had an education level up to primary school, while a smaller proportion, 8.9%, achieved an education level beyond undergraduate. Regarding healthcare expenses, 40.7% of the patients were self-financing, whereas 52.0% were covered by medical insurance, each group representing nearly half of the total.15.3% of patients live alone. 60.3% have been practicing ISC for no more than one year. Only 19.9% have not had a urinary tract infection within a year.Of the patients with NLUTD, 56.0% received ISC training during hospitalization; however, post-discharge, only 26.6% had access to continued ISC support.

3.2 Agree ratio and scores for each item of the I-CAT among participants

The agree ratio used in this study was defined as the sum of values for very strongly agree and agree divided by the total value for all categories in percentages. Figure 1 presents the agree ratio as well as the mean scores (with standard deviations) for each item. Approximately 46.5% of patients reported difficulty in accepting ISC. Additionally, over 50% of participants' scores on the I-CAT questionnaire indicated the presence of fear and low self-esteem.

Additionally, we observed that the average score for each item exceeded 2, nearing 3. The item with the highest score was “I am afraid that I may never fully regain my health” (2.97 ± 0.91), with 76.3% of respondents agreeing. The second highest score was for “I am afraid that, over time, self-catheterization will damage my urethra” (2.91 ± 0.84), with 75.5% of respondents in agreement.

3.3 The relationship between the independent variables

Table 2 presents the correlation coefficients between the independent variables, including demographic and clinical characteristics, and the study instrument. It was observed that the I-

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CAT score had a strong positive correlation with ISC training (r=0.861, P< 0.01) and ISC follow-up (r=0.766, P<0.01). Conversely, the I-CAT score had a strong negative correlation with psychological well-being scores (r = -0.774, P < 0.01).

3.4 Factors influencing ISC acceptance among NLUTD patients

Based on the results of multiple linear regression and I-CAT scores (where higher scores indicate lower psychological acceptance of ISC), we conclude the following: Patients experiencing more than two urinary tract infections (UTIs) per year have greater difficulty accepting ISC psychologically compared to those with no annual UTIs (β =1.180, P < 0.05). Patients using single-use hydrophilic-coated catheters and gel pre-lubricated single-use catheters find ISC more acceptable compared to those using non-hydrophilic coated catheters (β = -4.649, P < 0.05; β = -3.771, P < 0.05). Furthermore, patients without ISC training and follow-up support face more psychological challenges in accepting ISC than those who received such support (β =8.180, P < 0.05; β =7.314, P < 0.05). Additionally, higher satisfaction with ISC correlates with lower psychological acceptance (β =0.490, P < 0.01). Higher ISC-related quality of life is associated with higher psychological acceptance (β = -0.234, P < 0.01). These factors, including UTIs, catheter type, ISC satisfaction, and ISC-related quality of life, significantly influence psychological acceptance of ISC. These variables account for 82.5% of the total variance, with statistically significant results (F=193.687, P<0.001), as shown in Table 3.

4. DISCUSSION

To our knowledge, this study is the first to systematically investigate the psychological acceptance of ISC among NLUTD patients. The results indicate that the psychological acceptance of ISC among NLUTD patients is not encouraging, with nearly half (46.5%) finding it difficult to accept ISC. Over 50% of participants had I-CAT scores suggesting issues with fear and low self-esteem. Our study found that I-CAT scores were positively correlated with ISC training and follow-up support, while negatively correlated with ISC-related psychological health scores. Further analysis revealed that ISC training, follow-up support, urinary tract infections, catheter type, and quality of life significantly influenced patients' psychological acceptance of ISC.

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This study revealed that NLUTD patients encountered significant psychological challenges during the process of accepting ISC.A majority of patients held a pessimistic view of their health recovery (76.3%), feared potential urethral damage (75.8%), and were afraid of discomfort during the procedure (56.6%). These results starkly contrast with previous studies, where patients exhibited confidence in ISC [20]. This disparity may be attributed to the fact that only 56% of patients in this study received ISC training, and 77.6% had a lower educational level[21]. The study underscores the crucial role of healthcare providers in enhancing patient education and training [22], suggesting that targeted ISC training can significantly improve patients' self-catheterization abilities[23], thereby promoting ISC acceptance. The findings further confirm that ISC training is a key factor influencing psychological acceptance (β =8.180, $P < 0.05$). Therefore, future research should focus on optimizing ISC health education and training systems, developing personalized and easily understandable training programs to improve patient knowledge and skills, reduce misconceptions and fears about ISC, and enhance psychological acceptance.

This study identified significant correlations between psychological health (r = -0.774, $P < 0.01$) and operational difficulty (r= -0.341, $P < 0.01$) with the psychological acceptance of ISC. Patients often experience feelings of shame, embarrassment, and anxiety when using ISC, which lead to avoidance behaviors and consequently lower psychological acceptance of ISC[8]. Additionally, concerns about the complexity of the procedure and long-term risks further contribute to resistance[9]. Encouragingly, the study found that ISC follow-up support plays a crucial role in improving acceptance among NLUTD patients (β =7.314, $P < 0.05$), particularly in reducing operational difficulties and enhancing psychological health. Through ISC follow-up support, healthcare teams can provide continuous education, promptly address operational issues, and offer necessary psychological support[21].This approach not only boosts patients' confidence in performing ISC but also alleviates resistance caused by operational difficulties and psychological stress. The findings suggest that clinical practice should include enhanced psychological health assessments and operational guidance, along with systematic follow-up support, to improve treatment experiences and overall quality of life for patients.

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Additionally, recurrent UTIs significantly impact the acceptance of ISC among NLUTD patients (β =1.180, $P < 0.05$), aligning with previous studies[24]. Repeated UTIs cause patients to question the safety and efficacy of ISC, fearing long-term negative health effects, thus leading to greater hesitation and resistance[25]. Furthermore, UTI symptoms such as frequent urination, painful urination, urgency, and incontinence not only cause physical discomfort but also disrupt work, social activities, and daily life, increasing psychological stress and further reducing ISC acceptance [26]. Hence, this study's findings underscore the need to prioritize patients with recurrent UTIs for targeted interventions, which could significantly enhance their acceptance of ISC in clinical practice.

This study demonstrates that catheter type significantly impacts the psychological acceptance of ISC among NLUTD patients. Compared to non-hydrophilic-coated catheters, single-use hydrophilic-coated catheters and gel pre-lubricated catheters are more psychologically acceptable due to their advantages of reducing friction, lowering pain, simplifying the procedure, and decreasing infection risk [27,28]. However, this study found that 58.7% of patients chose non-hydrophilic-coated catheters, likely due to economic factors. With the annual cost of ISC catheters and accessories reaching up to 1,747 euros [29], this poses a significant financial burden on the 51.4% of unemployed patients in this study, accounting for one-third of the annual income for 83.8% of the patients, particularly the 40.7% who pay out of pocket. Therefore, healthcare providers should consider patients' economic situations when recommending catheters. Policymakers and insurance companies should consider reimbursing the costs of catheters and accessories and explore establishing charitable funds or subsidy mechanisms to alleviate patients' financial burden, thus enhancing the psychological acceptance and adherence to ISC.

This study underscores the pivotal role of ISC-related quality of life in influencing patients' psychological acceptance, particularly regarding usability, convenience, and mental health. Binny Pinder et al.'s research corroborates this, emphasizing the importance of catheter usability across different countries[30]. Enhancing catheter design, particularly by reducing preparation time and improving portability[11], is expected to reduce patients' anxiety and stress during ISC, thereby promoting daily functioning and social participation [11]. Beyond physical challenges, patients

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also face psychological adaptation issues to this invasive procedure[5], including embarrassment, shame, and anxiety, which significantly impede ISC acceptance [31]. Poor psychological adaptation can lead to treatment discontinuation[31]. Thus, ISC education and support strategies should adopt a holistic approach, encompassing technical training, improving catheter usability and convenience, and facilitating psychological adaptation through social support.

Our study revealed a surprising phenomenon: previous research typically considered patient satisfaction with ISC as a key factor in promoting psychological acceptance [21,30]. However, our findings indicate that higher satisfaction with ISC is associated with lower psychological acceptance (β=0.490, $P < 0.01$). Possible reasons include: firstly, high expectations can lead to disappointment when actual problems arise, especially for patients expecting optimal lubrication. Secondly, high satisfaction does not necessarily equate to confidence in performing ISC, as a lack of self-efficacy may cause hesitation. Additionally, in the context of Chinese culture, traditional health beliefs emphasize bodily integrity and dignity, leading some patients to perceive ISC as an infringement on bodily integrity, thus increasing psychological barriers [32]. Concerns about social stigma, privacy, and bodily integrity may further exacerbate conflicting emotions[8,32], affecting psychological acceptance. Therefore, strategies to improve the psychological acceptance of ISC should consider patients' mental state, personal beliefs, and socio-cultural background, adopting personalized and culturally sensitive education and support methods.

5. CONCLUSION

This study is the first to evaluate the psychological acceptance of ISC and comprehensively explore the influencing factors among patients with NLUTD. The research found that NLUTD patients generally face psychological challenges when accepting ISC, and their acceptance is influenced by various factors. Specifically, ISC training, follow-up support, and good psychological health significantly improve patients' acceptance of ISC. Conversely, recurrent urinary tract infections and the use of non-hydrophilic catheters are major barriers. Therefore, healthcare professionals need to focus on patients who struggle with the psychological acceptance of ISC and develop targeted intervention strategies. These strategies should aim to enhance factors that promote ISC acceptance and reduce obstacles, thereby improving patients'

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psychological acceptance and adherence, ultimately leading to significantly better treatment outcomes and quality of life.

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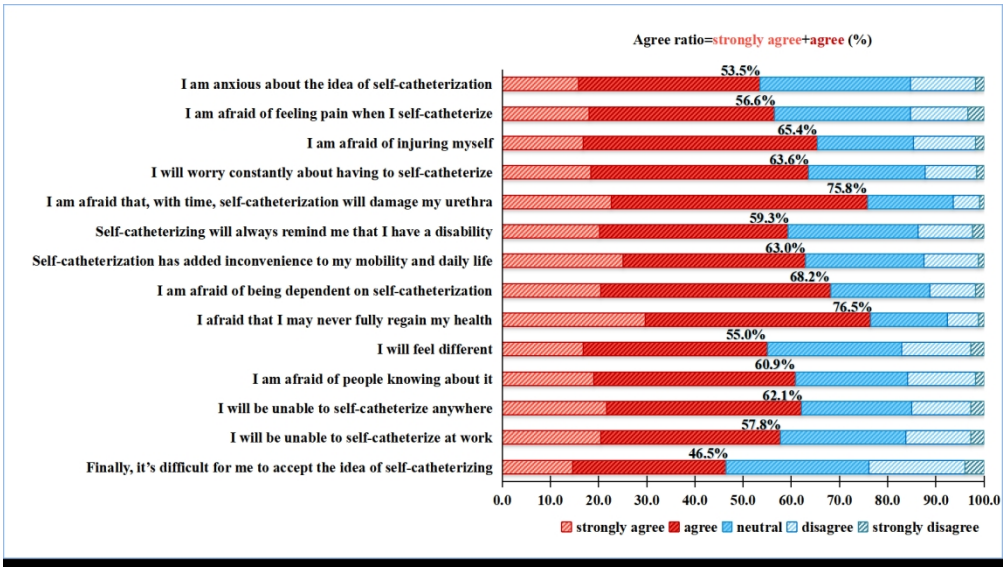

Figure 1.The agree ratio and the mean scores (with standard deviations) for the 14 items are provided.

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Table 1. Demographic and clinical characteristics of respondent (*n*=327).

Variables	Frequency	Percentage (%)
Age (year)		
18＜years≤35	122	37.3
35＜years≤45	114	34.9
45＜years≤65	91	27.8
Gender		
Male	193	59.0
Women	134	41.0
Marital status		
Unmarried	90	27.5
Married	198	60.6
Divorced	39	11.9
Occupation		
Unemployed	168	51.4
Employed	159	48.6
Family residence		
City	82	25.1
Town	74	22.6
Countryside	171	52.3
Personal monthly income (RMB)[c]		
≤3000	274	83.8
＞3000	53	16.2
Education level		
Primary schools	180	55.0
Junior high school	74	22.6
Senior high school	44	13.5
Bachelor's degree and above	29	8.9
Medical expenses payment method		
Self-paid	133	40.7
Medical insurance	170	52.0
Work-related injury insurance	11	3.3

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Variables	Frequency	Percentage (%)
Others	13	4.0
Residential living arrangements		
Solo living	50	15.3
Co-inhabiting with one individual	65	19.9
Living with two to three individuals	167	51.1
Living with four to six individuals	45	13.7
Duration of carrying out ISC		
0＜years≤ 1	197	60.3
1＜years≤5	56	17.1
5＜years	74	22.6
Urinary tract infection		
0 times/year	65	19.9
0＜times/year≤2	174	53.2
2＜times/year	88	26.9
Types of catheters		
Non-hydrophilic-coated catheters	192	58.7
Single-use hydrophilic-coated catheters	72	22.0
Pre-lubricated single-use gel catheters	36	11.0
Reusable catheters	27	8.3
ISC training		
Yes	183	56.0
No	144	44.0
ISC follow-up		
Yes	87	26.6
No	240	73.4

Note: [c]1 EUR = 7.79RMB; NLUTD, Neurogenic Lower Urinary Tract Dysfunction; ISC, Intermittent self-catheterization; I-CAT, Intermittent catheterization acceptance test; SD, Standard deviation.

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Table 2. The relationship between the independent variables (n=327).

Variables	Total score	Multiple fears	Self-esteem	Global question
Age (year)	-0.086	-0.081	-0.088	-0.047
Gender	0.052	0.018	0.060	0.048
Marital status	0.002	-0.001	-0.002	-0.031
Occupation	0.012	-0.020	0.018	0.025
Family residence	0.051	0.025	0.061	0.081
Personal monthly income (RMB)[c]	0.076	0.079	0.079	0.009
Education level	0.024	0.020	0.018	-0.005
Medical expenses payment method	-0.015	-0.053	0.010	-0.016
Residential living arrangements	0.065	0.031	0.085	0.024
Duration of carrying out ISC	-0.087	-0.073	-0.079	-0.119*
Urinary tract infection	0.032	0.046	0.024	0.014
Types of catheters	-.0538**	-0.490**	-0.514**	-0.431**
ISC training	0.861**	0.754**	0.825**	0.683**
ISC follow-up	0.766**	0.702**	0.730**	0.620**
InCaSaQ	0.100	0.066	0.118*	0.057
Packaging	0.147**	0.102	0.170**	0.089
Lubrication	0.105	0.088	0.114*	0.049
Catheter itself	0.050	0.025	0.066	0.020
After catheterization	0.012	0.004	0.014	0.027
ICDQ	0.341**	0.323**	0.320**	0.296**
Intensity	0.320**	0.310**	0.295**	0.284**
Frequency	0.342**	0.317**	0.327**	0.290**
ISC-Q	-0.551**	-0.500**	-0.538**	-0.444**
Ease of use	-0.288**	-0.324**	-0.234**	-0.264**
Convenience	-0.574**	-0.530**	-0.558**	-0.438**
Privacy	0.068	0.071	0.061	0.048
Psychological well-being	-0.774**	-0.697**	-0.759**	-0.625**

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Note: ᶜ1 EUR = 7.79RMB; NLUTD, Neurogenic Lower Urinary Tract Dysfunction; ISC, Intermittent self-catheterization; InCaSaQ, Intermittent catheterization satisfaction questionnaire; ICDQ, Intermittent catheterization difficulty questionnaire; ISC-Q, Intermittent self-catheterization questionnaire; I-CAT, Intermittent catheterization acceptance test; *$P<0.05$； **$P<0.01$. For categorical independent variables, the relationship with I-CAT scores is analyzed using Spearman's rank correlation. For continuous independent variables, the relationship with I-CAT scores is determined using Pearson's correlation analysis.

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Table 3. Factors influencing I-CAT scores among NLUTD patients by multiple linear regressions analysis(n=327).

Variables	*B*	SE	*β*	*t*	*P* value	95% CI for *B*		VIF
						Lower	Upper	
Constant	31.418	1.873		16.772	0.000	27.733	35.104	
Education level								
Primary schools	Reference category	-	-	-		-	-	-
Junior high school	-1.044	0.591	-0.041	-1.767	0.078	-2.208	0.119	1.028
Urinary tract infection								
0 times/year	Reference category	-	-	-		-	-	
2＜times/year	1.180	0.555	0.050	2.127	0.034	0.089	2.271	1.017
Types of catheters								
Non-hydrophilic-coated catheters	Reference category	-	-	-		-	-	
Single-use hydrophilic-coated catheters	-4.649	1.162	-0.183	-4.001	0.000	-6.935	-2.363	3.896
Pre-lubricated single-use gel catheters	-3.771	1.237	-0.112	-3.049	0.002	-6.204	-1.338	2.518
ISC training								
Yes	Reference category	-	-	-		-	-	-
No	8.180	0.667	0.385	12.273	0.000	6.869	9.491	1.840
ISC follow-up support								
Yes	Reference category	-	-	-	-	-	-	-
No	7.314	1.102	0.307	6.635	0.000	5.145	9.483	3.987
ISC-Q	-0.234	0.032	-0.219	-7.295	0.000	-0.298	-0.171	1.680
InCaSaQ	0.490	0.074	0.174	6.606	0.000	0.344	0.636	1.298

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Note: R^2=0.830,adjusted R^2=0.825,*F*=193.687, *P*<0.001. *B*, partial regression coefficient for the constant. SE, the standard error around the coefficient for the constant. *β*, standard partial regression coefficient.NLUTD, Neurogenic Lower Urinary Tract Dysfunction. I-CAT, Intermittent catheterization acceptance test. ISC-Q, Intermittent self-catheterization questionnaire.InCaSaQ, Intermittent catheterization satisfaction questionnaire.

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Appendix 1: STROBE Statement—Checklist of items that should be included in reports of cross-sectional studies

Section/Topic	Item	Checklist Item	Reported on Page #.
Title and abstract			
	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	#1 Title
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	#2-3 Abstract
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	#4 Introduction, 1st to 2rd paragraphs
Objectives	3	State specific objectives, including any prespecified hypotheses	#4 Introduction,3rd paragraph
Methods			
Study design	4	Present key elements of study design early in the paper	# 5 Methods, Study design and participants
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	# 5-6 Methods, Study design and participants, and data collection procedure
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	# 5 Methods, Study design and participants
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	# 7-8 Methods, I-CAT, InCaSaQ, ICDQ, and ICDQ
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	# 8 Methods, Data analysis
Bias	9	Describe any efforts to address potential sources of bias	# 5-6 Methods, Data collection procedure
Study size	10	Explain how the study size was arrived at	# 6 Methods, Sampling
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	# 8 Methods, Data analysis
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	# 8 Methods, Data analysis
		(*b*) Describe any methods used to examine subgroups and interactions	Not applicable
		(*c*) Explain how missing data were addressed	Not applicable
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(*e*) Describe any sensitivity analyses	Not applicable
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	# 8-9 Results, Figure 1 in the Data analysis
		(b) Give reasons for non-participation at each stage	Not applicable

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		(c) Consider use of a flow diagram	Not applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1
		(b) Indicate number of participants with missing data for each variable of interest	#8-9Results,Participant characteristics in Table 1
Outcome data	15*	Report numbers of outcome events or summary measures	Not applicable
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Not applicable
		(*b*) Report category boundaries when continuous variables were categorized	Not applicable
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Not applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	# 10 Discussion,1rd paragraph
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	# 2 Strengths and limitations of this study, limitations
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	# 10-13 Discussion,2st to 7rd paragraphs
Generalisability	21	Discuss the generalisability (external validity) of the study results	# 13, Conclusions
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	# Title page

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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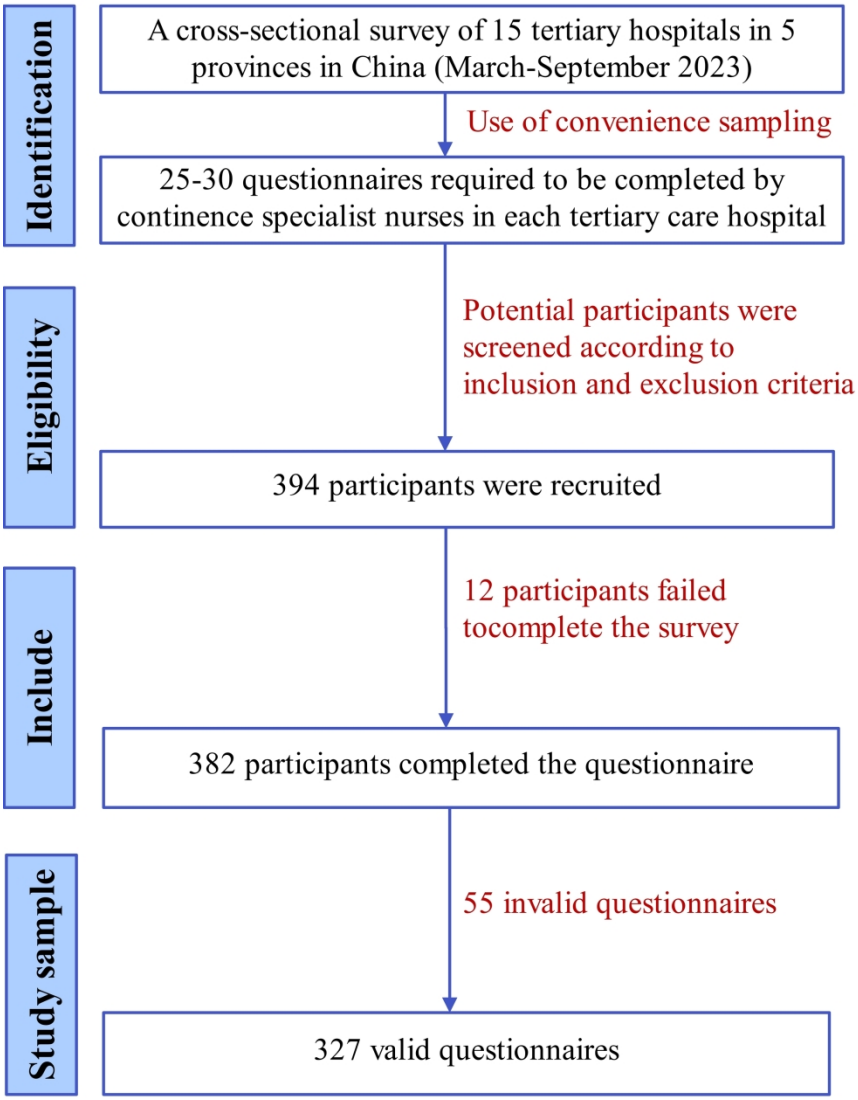

Appendix_2. Flow diagram of the questionnaire collection and selection process.

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Appendix_3. Assigned values of independent variables.

Variables	Description/Recoding
Age (year)	18＜years≤35=1, 35＜years≤45=2, 45＜years≤65=3
Gender	Male=1,Women=2
Marital status	Unmarried=1, Married=2, Divorced=3
Occupation	Unemployed=1, Employed=2
Family residence	City=1,Town=2,Countryside=3
Personal monthly income (RMB)[c]	≤3000=1, ＞3000=2
Education level	Primary schools=1, Junior high school=2, Senior high school=3, Bachelor's degree and above=4
Medical expenses payment method	Self-paid=1, Medical insurance=2, Work-related injury insurance=3, Others=4
Residential living arrangements	Solo living=1, Co-inhabiting with one individual=2, Living with two to three individuals=3, Living with four to six individuals=4
Duration of carrying out ISC	0＜years ≤ 1=1, 1＜years ≤5=2, 5＜years=3
Urinary tract infection	0 times/year=1, 0＜times/year≤2=2, 2＜times/year=3
Types of catheters	Non-hydrophilic-coated catheters=1, Single-use hydrophilic-coated catheters=2, Pre-lubricated single-use gel catheters=3, Reusable catheters=4
ISC training	Yes=1, No=2
ISC follow-up	Yes=1, No=2

Note: [c]1 EUR = 7.79RMB; ISC follow-up support (including face-to-face communication, telephone communication, home visits, online educational platforms, and text messages)

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Acceptance and the influencing factors towards intermittent self-catheterization among patients with neurogenic lower urinary tract dysfunction in China: a multi-centers cross-sectional study

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Abstract

Objectives

The psychological acceptance of Intermittent Self-Catheterization (ISC) significantly impacts its initial adoption and long-term compliance among patients. However, our understanding of this acceptance remains limited. This study aims to investigate ISC's psychological acceptance and identify influencing factors among neurogenic lower urinary tract dysfunction (NLUTD) patients in China.

Design

A cross-sectional study design.

Participants

A total of 394 patients with NLUTD were recruited from 15 tertiary general hospitals in China.

Outcome measure

The patients completed a comprehensive questionnaire that included demographic and clinical characteristics, along with study instruments such as the Intermittent Catheterization Acceptance Test (I-CAT), the Intermittent Catheterization Satisfaction Questionnaire (InCaSaQ), the Intermittent Catheterization Difficulty Questionnaire (ICDQ), and the Intermittent Self-Catheterization Questionnaire (ISC-Q). Pearson's correlation analysis explored interrelationships among questionnaire scores, while Spearman's correlation assessed relationships between categorical independent variables and I-CAT scores. Additionally, multiple linear regression analysis identified key factors influencing psychological acceptance of ISC.

Results

Nearly half of the participants (46.2%) reported psychological challenges in accepting ISC, and more than 50% of the participants exhibited fear and low self-esteem in their I-CAT questionnaire scores. The I-CAT scores were strongly correlated with ISC training (r=0.861), ISC follow-up (r=0.766), and psychological well-being (r=-0.774). Regression analysis identified significant factors influencing ISC acceptance, including urinary tract infections, types of

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catheters, ISC training, ISC follow-up, province and scores on the ISC-Q and InCaSaQ questionnaires, which collectively explained 85.5% of the variance in acceptance rates (F=161.409).

Conclusions

Psychological difficulties in accepting ISC are prevalent among NLUTD patients. Key factors that facilitate ISC acceptance include receiving ISC training, follow-up support, and favorable ISC-Q scores. In contrast, barriers like the use of non-hydrophilic catheters present significant challenges.Notably, ISC acceptance varies significantly across different regions. Therefore, targeted strategies are recommended to enhance positive factors, reduce negative ones, and consider regional disparities, thereby improving overall ISC acceptance.

Strengths and limitations of this study

- A multi-center design was employed, encompassing 15 tertiary hospitals across five Provinces in China, thereby increasing the diversity and representativeness of the sample.
- Validated instruments (I-CAT, InCaSaQ, ICDQ, and ISC-Q) were utilized to comprehensively assess patients' experiences and perceptions of ISC.
- The data collection process was rigorously implemented, including standardized training for investigators and strict criteria for excluding invalid or incomplete questionnaires.
- As a cross-sectional study, it identifies factors associated with ISC acceptance but is limited in establishing causality.
- The use of self-reported data introduces risks of recall bias and social desirability bias, which may affect the accuracy of the findings.

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1.INTRODUCTION

Neurogenic Lower Urinary Tract Dysfunction (NLUTD) is a condition characterized by bladder or urethral dysfunction due to neurological disorders, commonly found in patients with spinal cord injury, stroke, Parkinson's disease, and multiple sclerosis [1]. These conditions disrupt neural transmission, leading to uncoordinated bladder and urethral function, resulting in urinary retention, incontinence, urinary tract infections, and upper urinary tract damage [1, 2]. NLUTD not only causes severe physiological symptoms but also significantly impacts patients' mental health and social life, while increasing the economic burden on healthcare systems [3].

Since Lapides introduced ISC in 1972, ISC has become the standard treatment for NLUTD [4,5]. ISC enables patients to void independently, reducing the risks of urinary tract infections and kidney damage, and thereby significantly enhancing their quality of life [5]. Despite the well-documented clinical efficacy and technical advantages of ISC, its global implementation and adherence rates remain below expectations [6]. For instance, in China, the implementation rate is only around 20% [7]. This indicates a substantial gap between guideline recommendations and actual clinical practice. The psychological acceptance of ISC by patients significantly influences its adoption and sustained adherence [8], which is crucial for successful ISC implementation [9]. However, there is limited knowledge about the factors affecting psychological acceptance of ISC. Current qualitative studies suggest that procedural complexity, difficulty, negative emotions such as fear and embarrassment, and low satisfaction with ISC devices may impact patients' acceptance and adherence [8,10–13].

Therefore, this study aims to conduct a cross-sectional, multicenter survey to comprehensively quantify patients' psychological acceptance of ISC and explore its influencing factors. Special focus will be placed on ISC satisfaction, operational difficulty, and their relationship with the quality of life. This research seeks to fill existing gaps, providing scientific evidence to improve the psychological acceptance of ISC in clinical practice. It will aid in the development of more effective clinical guidelines and policies, increase ISC implementation and adherence rates, and ultimately enhance patients' quality of life.

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2.METHODS

2.1 Study design

This study was conducted from March to September, 2023, in 15 tertiary general hospitals across five provinces in China, namely Hubei, Henan, Sichuan, Anhui and Guangdong . These hospitals are acknowledged as critical centers for healthcare, education, and research, each with a minimum of 500 beds [14]. A convenience sampling and cross-sectional study design were employed.

2.2 Participants

Participants were included based on the following criteria: (1) aged between 18 and 65 years; (2) diagnosed with NLUTD resulting from central nervous system injuries, such as spinal cord injury, multiple sclerosis, stroke, spina bifida, or Parkinson's disease; (3) At least 6 months of current or prior practice of ISC. The exclusion criteria were: (1) cognitive impairments, visual impairments, or hand function impairments; (2) other comorbidities, including urethral stricture, bladder or kidney stones, or rectal dysfunction. To improve the quality and transparency of the research, the team employed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement checklist (See Supplemental table 1).

2.3 Data collection procedure

The online survey was facilitated through the “Questionnaire Star”, a widely-utilized online platform within the industry. After obtaining consent from specialized incontinence nurses at fifteen tertiary comprehensive hospitals, the nurses received online training. Upon finalizing the questionnaire’s design, researchers uploaded it to the Questionnaire Star software, generating a unique link. Investigators who completed the training and passed the competency test were officially authorized to conduct the survey.

The researchers distributed the survey link to the principal investigators at each participating center, with a request for 25-30 patients to complete the survey. Specialized incontinence nurses recruited eligible patients in outpatient clinics and provided face-to-face guidance on completing

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the electronic questionnaire. This ensured that each patient accurately understood the questionnaire content and could complete it independently. Detailed explanations and instructions regarding the study's purpose, methods, and considerations were provided on the first page of the Questionnaire Star. Each participant had to read and agree to the participation statement before starting the questionnaire, ensuring informed consent and their right to withdraw from the study at any time without adverse consequences.

To ensure the integrity of the survey, this study required all questions to be answered, and each IP address was allowed to submit the questionnaire only once. Meanwhile, to improve data quality, invalid and incomplete questionnaires were strictly filtered. Invalid questionnaires were defined as those with identical scores across all items, linear sequential scores (e.g., 1, 2, 3, 4, 5 or 5, 4, 3, 2, 1), or a completion time of less than 360 seconds. Incomplete questionnaires referred to those where respondents exited before completing all questions. To ensure the reliability of the analysis results, these invalid and incomplete questionnaires were removed before the analysis. Upon approval from the research team, participants received a compensation of 20 RMB (approximately 3.0 USD).The sample screening process is shown in Supplemental figure 1.

2.4 Sampling

The sample size was calculated by multiplying the total number of independent variables, which include demographic and clinical characteristics as well as the quantity of scales, by 15, yielding a total of 300 (N = 18×15 = 270). To account for a potential 20% nonresponse rate, a minimum sample size of 338 is required.

2.5 Outcome measures

2.5.1The Intermittent Catheterization Acceptance Test (I-CAT)

The I-CAT was designed to assess individuals' psychological acceptance of practicing ISC and was developed by Guinet-Lacoste et al in 2016 [15].This scale contains 14 items and consists of three dimensions, including multiple fears, self-esteem and global question. The items are scored from 0 (strongly disagree) to 4 (strongly agree). A higher score on the I-CAT signifies a lower level of psychological acceptance of ISC. The Chinese version of I-CAT was utilized in this

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study, demonstrating good reliability and validity [16]. In this study, the Cronbach's alpha coefficient was 0.946.

2.6 Influencing factors

The questionnaire comprised two sections: demographic and clinical characteristics, and study instruments, such as the InCaSaQ [17], the ICDQ [18], and the ISC-Q [19].

2.6.1 Demographic and clinical characteristics of patients

The participants' demographic and clinical characteristics included information on age, gender, marital status, occupation, family residence, personal monthly income, education level, medical expenses payment method, residential living arrangements, duration of performing ISC, urinary tract infections, types of catheters, ISC training (whether they received knowledge and skills training on ISC during hospitalization),ISC follow-up (whether they received post-discharge hospital support for ISC) and province.

2.6.2 Study instrument

(1) The Intermittent Catheterization Satisfaction Questionnaire (InCaSaQ)

The InCaSaQ for assessing patient satisfaction with ISC, developed by Guinet-Lacoste et al in 2014 [17].This scale contains 8 items and consists of four dimensions, including packaging, lubrication, catheter itself and after catheterization. The items are scored from 0 (extremely dissatisfied) to 3 (extremely satisfied). A higher total score on the InCaSaQ indicates greater satisfaction of ISC. In this research, the Cronbach's alpha coefficient registered at 0.895.

(2) The Intermittent Catheterization Difficulty Questionnaire (ICDQ)

The ICDQ was designed to evaluate the challenges patients face when performing ISC and was developed by Guinet-Lacoste et al in 2014 [18].This scale 13 items contains two categories, including frequency and intensity. The instrument explicitly describes the ease of catheter insertion and withdrawal, the presence of pain, limb spasticity, urethral sphincter spasms, and local urethral bleeding during catheterization. The ICDQ employs a four-point Likert-type scale, with scores ranging from 0 ("None" for intensity or "Never" for frequency) to 3 ("Considerable"

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for intensity or "Always" for frequency). A higher overall score on the ICDQ indicates greater difficulty. Within this study, the Cronbach's alpha was measured at 0.943.

(3) The Intermittent Self-Catheterization Questionnaire (ISC-Q)

The ISC-Q was meticulously developed by Binny Pinder and colleagues in 2012 [19]. Designed for completion by ISC patients, the questionnaire aims to evaluate the quality of life related to their unique needs, encompassing both physical and psychological concerns. This scale contains 24 items and consists of four dimensions, including ease of use, convenience, discreetness, and psychological Well-being. A 5-point Likert scale, ranging from 0 (strongly disagree) to 4 (strongly agree), is employed. After converting responses from 14 reverse-coded items, scores are calculated by averaging the items within each dimension and then multiplying by 25, yielding a universal range of 0-100. The overall ISC-Q score is derived from the mean values across the four dimensions, with a higher ISC-Q score indicating a more favorable QOL in relation to ISC. In this study, the the Cronbach's alpha was 0.821.

2.7 Ethics statement

All participating centers in this study adhered to ethical standards, with the research conducted under the approval of the Medical Ethics Committee of the lead institution, Shenzhen Hospital, Southern Medical University (Approval No. NYSZYYEC20230031). This approval was recognized and accepted by all other participating hospitals. Each center conducted patient recruitment and data collection in compliance with the approved ethical guidelines. All participants provided electronic informed consent and voluntarily completed the online survey. Additionally, all information obtained from the participants is strictly confidential and anonymized.

2.8 Patient and Public Involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

2.9 Data analysis

Statistical Package for Social Sciences (SPSS 26.0 for Windows) was used to conduct data

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analyses. Descriptive statistics such as means, standard deviations (SD), and frequencies were used to examine the main characteristics. The χ^2 test was used to evaluate the distribution differences in questionnaire completion status (including incomplete, invalid, and valid responses) across different provinces. Spearman's analysis is used to examine the relationship between categorical independent variables and continuous dependent variables, while Pearson's analysis evaluates the relationship between continuous independent variables and continuous dependent variables.Demographic and clinical characteristics, InCaSaQ, ICDQ, and ISC-Q were included in a multivariate linear analysis to identify the main factors influencing ISC psychological acceptance. These models were created using a backward selection method. Significance for all statistical tests was set at 0.05 (2-tailed).The categorical independent variables were recoded (assignment) before stepwise linear regression analysis (See Supplemental table 2).The variance inflation factor (VIF) was used to assess multicollinearity among the predictors.

3. RESULTS

3.1 Participant characteristics

Based on the inclusion and exclusion criteria, a total of 394 questionnaires were collected from five provinces, among which 12 were incomplete and 55 were invalid, resulting in 327 valid questionnaires with an effective rate of 83.0%. Details of incomplete and invalid questionnaires by province are shown in Supplemental figure 2. Chi-square test results indicated no significant differences in the distribution of incomplete and invalid questionnaires among the provinces (χ^2=4.08, P=0.85). The sample distribution is presented in Supplemental table 3 and the demographic and clinical characteristics of the 327 valid respondents are detailed in Table 1. A majority of the respondents (72.2%) were aged between 18 and 45 years. Over half of the participants were male (59.0%). Approximately 60.6% of the patients were married. Half of the patients were unemployed (51.4%) and hailed from rural areas (52.3%). A significant portion, exceeding half, reported a monthly income below 3000 yuan (83.8%). Approximately 55.0% of the respondents had an education level up to primary school, while a smaller proportion, 8.9%, achieved an education level beyond undergraduate. Regarding healthcare expenses, 40.7% of the patients were self-financing, whereas 52.0% were covered by medical insurance, each group representing nearly half of the total.15.3% of patients live alone. 60.3% have been practicing ISC

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for no more than one year. Only 19.9% have not had a urinary tract infection within a year.Of the patients with NLUTD, 56.0% received ISC training during hospitalization; however, post-discharge, only 26.6% had access to continued ISC support.The distribution of valid samples collected from each province is similar, with Sichuan having the highest proportion at 21.4%.

3.2 Agree ratio and scores for each item of the I-CAT among participants

The agree ratio used in this study was defined as the sum of values for very strongly agree and agree divided by the total value for all categories in percentages. Figure 1 presents the agree ratio as well as the mean scores (with standard deviations) for each item. Approximately 46.2% of patients reported difficulty in accepting ISC. Additionally, over 50% of participants' scores on the I-CAT questionnaire indicated the presence of fear and low self-esteem.

Additionally, we observed that the average score for each item exceeded 2, nearing 3. The item with the highest score was “I am afraid that I may never fully regain my health” (2.97 ± 0.91), with 76.3% of respondents agreeing. The second highest score was for “I am afraid that, over time, self-catheterization will damage my urethra” (2.91 ± 0.84), with 75.5% of respondents in agreement.

3.3 The relationship between the independent variables

Table 2 presents the correlation coefficients between the independent variables, including demographic and clinical characteristics, and the study instrument. It was observed that the I-CAT score had a strong positive correlation with ISC training ($r = 0.861$, $P < 0.01$) and ISC follow-up ($r = 0.766$, $P < 0.01$). Conversely, the I-CAT score had a strong negative correlation with psychological well-being scores ($r = -0.774$, $P < 0.01$).

3.4 Factors influencing ISC acceptance among NLUTD patients

Based on the results of multiple linear regression and I-CAT scores (where higher scores indicate lower psychological acceptance of ISC), we conclude the following: Compared to patients without urinary tract infections (UTIs) each year, those experiencing 1-2 UTIs annually demonstrate a lower psychological burden in accepting ISC ($\beta = -0.905$, $P < 0.05$). Patients using

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single-use hydrophilic-coated catheters and gel pre-lubricated single-use catheters find ISC more acceptable compared to those using non-hydrophilic coated catheters (β = -4.409, $P < 0.05$; β = -3.132, $P < 0.05$). Furthermore, patients without ISC training and follow-up support face more psychological challenges in accepting ISC than those who received such support (β = 6.984, $P < 0.05$; β = 6.759, $P < 0.05$). In addition to these individual factors, regional differences also play a significant role. The acceptance of ISC was higher among patients from provinces other than the reference category, Hubei. Specifically, patients from Henan (β = -4.480), Sichuan (β = -3.885), Anhui (β = -5.611), and Guangdong (β = -6.195) showed significant differences in psychological acceptance of ISC ($P < 0.05$).

Additionally, higher satisfaction with ISC correlates with lower psychological acceptance (β = 0.417, $P < 0.01$). Higher ISC-related quality of life is associated with higher psychological acceptance (β = -0.206, $P < 0.01$). These factors, including UTIs, catheter type, ISC training, ISC follow-up support, Province, ISC satisfaction, and ISC-related quality of life, significantly influence psychological acceptance of ISC. These variables account for 85.5% of the total variance, with statistically significant results (F = 161.409, P <0.001), as shown in Table 3.

4. DISCUSSION

To our knowledge, this study is the first to systematically investigate the psychological acceptance of ISC among NLUTD patients. The results indicate that the psychological acceptance of ISC among NLUTD patients is not encouraging, with nearly half (46.2%) finding it difficult to accept ISC. Over 50% of participants had I-CAT scores suggesting issues with fear and low self-esteem. Our study found that I-CAT scores were positively correlated with ISC training and follow-up support, while negatively correlated with ISC-related psychological health scores. Further analysis revealed that urinary tract infections, ISC training, follow-up support, urinary tract infections, catheter type, province, ISC-related quality of life and ISC satisfaction significantly influenced patients' psychological acceptance of ISC.

This study revealed that NLUTD patients encountered significant psychological challenges during the process of accepting ISC.A majority of patients held a pessimistic view of their health

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recovery (76.3%), feared potential urethral damage (75.8%), and were afraid of discomfort during the procedure (56.6%). These results starkly contrast with previous studies, where patients exhibited confidence in ISC [20]. This disparity may be attributed to the fact that only 56% of patients in this study received ISC training, and 77.6% had a lower educational level [21]. The study underscores the crucial role of healthcare providers in enhancing patient education and training [22], suggesting that targeted ISC training can significantly improve patients' self-catheterization abilities [23], thereby promoting ISC acceptance. The findings further confirm that ISC training is a key factor influencing psychological acceptance ($\beta = 6.984$, $P < 0.05$). Therefore, future research should focus on optimizing ISC health education and training systems, developing personalized and easily understandable training programs to improve patient knowledge and skills, reduce misconceptions and fears about ISC, and enhance psychological acceptance.

This study identified significant correlations between psychological health ($r = -0.774$, $P < 0.01$) and operational difficulty ($r = -0.341$, $P < 0.01$) with the psychological acceptance of ISC. Patients often experience feelings of shame, embarrassment, and anxiety when using ISC, which lead to avoidance behaviors and consequently lower psychological acceptance of ISC [8]. Additionally, concerns about the complexity of the procedure and long-term risks further contribute to resistance [9]. Encouragingly, the study found that ISC follow-up support plays a crucial role in improving acceptance among NLUTD patients ($\beta = 6.759$, $P < 0.05$), particularly in reducing operational difficulties and enhancing psychological health. Through ISC follow-up support, healthcare teams can provide continuous education, promptly address operational issues, and offer necessary psychological support [21].This approach not only boosts patients' confidence in performing ISC but also alleviates resistance caused by operational difficulties and psychological stress. The findings suggest that clinical practice should include enhanced psychological health assessments and operational guidance, along with systematic follow-up support, to improve treatment experiences and overall quality of life for patients.

Additionally, patients who experienced UTIs 1-2 times per year were more likely to accept ISC compared to those without infections ($\beta = -0.905$, $P < 0.05$). This finding supports self-management theory, suggesting that a moderate level of UTIs experience may stimulate patient

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initiative, encouraging the adoption of more effective management strategies to reduce infection risk [24,25]. However, patients with higher UTIs frequency (more than twice per year) were excluded from the regression model, potentially due to the anxiety and helplessness induced by frequent infections, which may lead to doubts regarding the safety and efficacy of ISC [26]. Such attitudinal differences may stem from individual health experiences, disease perception, and cultural background, which directly impact ISC acceptance.Notably, the bias introduced by provincial factors played a critical role in this context. Compared to Hubei, patients in Henan, Sichuan, Anhui, and Guangdong exhibited higher acceptance of ISC ($P < 0.05$), suggesting that regional differences influence patient decision-making. The disparities in medical resources, cultural awareness, and social support across provinces directly shape attitudes toward ISC [7]. This highlights the need for healthcare providers to sensitively recognize the influence of UTIs frequency and regional differences on patient psychology and treatment preferences.

This study demonstrates that catheter type significantly impacts the psychological acceptance of ISC among NLUTD patients. Compared to non-hydrophilic-coated catheters, single-use hydrophilic-coated catheters and gel pre-lubricated catheters are more psychologically acceptable due to their advantages of reducing friction, lowering pain, simplifying the procedure, and decreasing infection risk [27,28]. However, this study found that 58.7% of patients chose non-hydrophilic-coated catheters, likely due to economic factors. With the annual cost of ISC catheters and accessories reaching up to 1,747 euros [29], this poses a significant financial burden on the 51.4% of unemployed patients in this study, accounting for one-third of the annual income for 83.8% of the patients, particularly the 40.7% who pay out of pocket. Therefore, healthcare providers should consider patients' economic situations when recommending catheters. Policymakers and insurance companies should consider reimbursing the costs of catheters and accessories and explore establishing charitable funds or subsidy mechanisms to alleviate patients' financial burden, thus enhancing the psychological acceptance and adherence to ISC.

This study underscores the pivotal role of ISC-related quality of life in influencing patients' psychological acceptance, particularly regarding usability, convenience, and mental health. Binny Pinder et al.'s research corroborates this, emphasizing the importance of catheter usability across different countries [30]. Enhancing catheter design, particularly by reducing preparation time and

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improving portability[11], is expected to reduce patients' anxiety and stress during ISC, thereby promoting daily functioning and social participation [11]. Beyond physical challenges, patients also face psychological adaptation issues to this invasive procedure [5], including embarrassment, shame, and anxiety, which significantly impede ISC acceptance [31]. Poor psychological adaptation can lead to treatment discontinuation [31]. Thus, ISC education and support strategies should adopt a holistic approach, encompassing technical training, improving catheter usability and convenience, and facilitating psychological adaptation through social support.

Our study revealed a surprising phenomenon: previous research typically considered patient satisfaction with ISC as a key factor in promoting psychological acceptance [21,30]. However, our findings indicate that higher satisfaction with ISC is associated with lower psychological acceptance ($\beta = 0.417$, $P < 0.01$). Possible reasons include: firstly, high expectations can lead to disappointment when actual problems arise, especially for patients expecting optimal lubrication. Secondly, high satisfaction does not necessarily equate to confidence in performing ISC, as a lack of self-efficacy may cause hesitation. Additionally, in the context of Chinese culture, traditional health beliefs emphasize bodily integrity and dignity, leading some patients to perceive ISC as an infringement on bodily integrity, thus increasing psychological barriers [32]. Concerns about social stigma, privacy, and bodily integrity may further exacerbate conflicting emotions [8,32], affecting psychological acceptance. Therefore, strategies to improve the psychological acceptance of ISC should consider patients' mental state, personal beliefs, and socio-cultural background, adopting personalized and culturally sensitive education and support methods.

This study utilized a multi-center design, encompassing 15 tertiary hospitals across five provinces in China, offering a high level of sample diversity and representativeness. This approach provided valuable insights into the psychological acceptance of ISC among patients with NLUTD in China. Furthermore, the study employed validated instruments, including the I-CAT, InCaSaQ, ICDQ, and ISC-Q scales, to systematically assess patients' experiences and acceptance of ISC, ensuring a comprehensive understanding of their psychological and perceptual responses. Through multiple linear regression analysis, key factors influencing ISC acceptance were identified, offering an in-depth analysis of the psychological determinants that shape patients'

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acceptance of ISC.

However, certain limitations should be acknowledged. First, the sample primarily consisted of patients from tertiary hospitals in five provinces, with no representation from secondary or primary healthcare institutions. As a result, the findings may more accurately reflect the psychological acceptance patterns of patients in tertiary care settings, limiting their applicability to those in primary healthcare facilities with fewer resources. Future research should expand the sample to include various levels of healthcare institutions to enhance the generalizability of the findings. Second, the cross-sectional design, while effective in identifying factors associated with ISC acceptance, does not establish causal relationships. Longitudinal studies that track patients over different time points are recommended to provide a more comprehensive understanding of the long-term impact of these factors on ISC acceptance. Additionally, the study relied on self-reported questionnaires, which are advantageous for capturing subjective patient experiences but may be affected by recall bias and social desirability bias, potentially impacting the accuracy of the results. Future studies could incorporate objective assessment tools, such as psychological interviews or professional evaluations, to minimize these biases.

In addition, the study did not distinguish between ambulatory patients and those who use wheelchairs, despite the fact that mobility can significantly impact quality of life and self-esteem. The lack of in-depth analysis of this group may limit the comprehensive understanding of their psychological state. Future research should focus on differences in psychological acceptance of ISC among patients with varying mobility abilities. Furthermore, the study did not examine the relationship between 'dryness' and both quality of life and self-esteem, which may limit the understanding of the connections between these factors. Similarly, bowel function and fecal incontinence were not assessed for their impact on self-esteem, even though these factors can significantly affect quality of life and psychological well-being, potentially influencing ISC acceptance. Future studies should explore the links between these physiological factors and mental health in greater depth. Lastly, although some patients received ISC training and follow-up support, variations in the content and frequency of these interventions across different hospitals may have affected the consistency of the results. Future research should aim to establish

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more standardized interventions across diverse regions and healthcare settings, incorporating longitudinal designs to comprehensively evaluate the relationships between mobility, dryness, bowel function, and psychological acceptance, thereby enhancing the generalizability and scientific validity of the findings.

5. CONCLUSION

This study is the first to evaluate the psychological acceptance of ISC and comprehensively explore the influencing factors among patients with NLUTD. The findings indicate that NLUTD patients often face psychological challenges when adopting ISC, with their acceptance influenced by various factors, including urinary tract infections, ISC training, follow-up support, catheter type, province, ISC-related quality of life, and ISC satisfaction. Notably, ISC acceptance varies significantly across different regions. Therefore, healthcare professionals should prioritize patients experiencing psychological difficulties with ISC and develop targeted intervention strategies, emphasizing localized approaches. These efforts can improve treatment outcomes and enhance patients' quality of life.

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Author contributions statement

Ling Chen and Wenzhi Cai developed the research methodology, with Laifu Wang and Dan Wu conducting the investigation. Data analysis was led by Fengming Hao, Yingjie Hu, and Senying Luo, while the original draft was prepared by Fengming Hao and Yingjie Hu. Senying Luo, Fengming Hao, and Yingjie Hu also contributed to the review and editing process under the

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supervision of Ling Chen and Wenzhi Cai. The overall responsibility, including resources and funding acquisition, was managed by Wenzhi Cai, who also served as the guarantor for this work.

Competing Interests statements

The authors declared no conflict of interest.

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Figure legends

Supplemental table 1. STROBE Statement—Checklist of items that should be included in reports of cross-sectional studies.

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Supplemental figure 1. Flow diagram of the questionnaire collection and selection process.

Supplemental table 2. Assigned values of independent variables.

Note: ᶜ1 EUR = 7.79RMB; ISC follow-up support (including face-to-face communication, telephone communication, home visits, online educational platforms, and text messages).

Supplemental figure 2. Distribution of incomplete and invalid questionnaires with frequencies and percentages by province.

Abbreviations:Qs, Questionnaires.

Supplemental table 3. Sample distribution status.

Note:The χ^2 test was used to evaluate differences in questionnaire completion status (including incomplete, invalid, and valid responses) across provinces. Results showed no significant differences in the distribution of incomplete and invalid questionnaires among provinces (χ^2=4.08, P=0.85). However, due to the small sample size in each hospital (25-30 questionnaires), the χ^2 test was not used to assess completion status differences across hospitals.

Abbreviations:Qs, Questionnaires.

Table 1. Demographic and clinical characteristics of respondent (*n*=327).

Note: ᶜ1 EUR = 7.79RMB; NLUTD, Neurogenic Lower Urinary Tract Dysfunction; ISC, Intermittent self-catheterization; I-CAT, Intermittent catheterization acceptance test; SD, Standard deviation.

Figure 1.The agree ratio and the mean scores (with standard deviations) for the 14 items are provided.

Note: Unacceptable ratio was the summated ratio of strongly agree (light red) and agree (dark red).

Table 2. The relationship between the independent variables (*n*=327).

Note: ᶜ1 EUR = 7.79RMB; NLUTD, Neurogenic Lower Urinary Tract Dysfunction; ISC, Intermittent self-catheterization; InCaSaQ, Intermittent catheterization satisfaction questionnaire; ICDQ, Intermittent catheterization difficulty questionnaire; ISC-Q, Intermittent self-catheterization questionnaire; I-CAT, Intermittent catheterization acceptance test; *$P<0.05$； **$P<0.01$. For categorical independent variables, the relationship with I-CAT scores is analyzed using Spearman's rank correlation. For continuous independent variables, the relationship with I-CAT scores is determined using Pearson's correlation analysis.

Table 3. Factors influencing I-CAT scores among NLUTD patients by multiple linear regressions analysis (*n*=327).

Note:R^2=0.830,adjusted R^2=0.825,F=193.687, P<0.001. B, partial regression coefficient for the constant. SE, the standard error around the coefficient for the constant. β, standard partial regression coefficient.NLUTD, Neurogenic Lower Urinary Tract Dysfunction. I-CAT, Intermittent catheterization acceptance test. ISC-Q, Intermittent self-catheterization questionnaire.InCaSaQ, Intermittent catheterization satisfaction questionnaire.

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Table 1. Demographic and clinical characteristics of respondent (n=327).

Variables	Frequency	Percentage (%)
Age (year)		
18＜years≤35	122	37.3
35＜years≤45	114	34.9
45＜years≤65	91	27.8
Gender		
Male	193	59.0
Women	134	41.0
Marital status		
Unmarried	90	27.5
Married	198	60.6
Divorced	39	11.9
Occupation		
Unemployed	168	51.4
Employed	159	48.6
Family residence		
City	82	25.1
Town	74	22.6
Countryside	171	52.3
Personal monthly income (RMB)[c]		
≤3000	274	83.8
＞3000	53	16.2
Education level		
Primary schools	180	55.0
Junior high school	74	22.6
Senior high school	44	13.5
Bachelor’s degree and above	29	8.9
Medical expenses payment method		
Self-paid	133	40.7
Medical insurance	170	52.0
Work-related injury insurance	11	3.3

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Variables	Frequency	Percentage (%)
Others	13	4.0
Residential living arrangements		
Solo living	50	15.3
Co-inhabiting with one individual	65	19.9
Living with two to three individuals	167	51.1
Living with four to six individuals	45	13.7
Duration of carrying out ISC		
0.5≤years≤ 1	197	60.3
1＜years≤5	56	17.1
5＜years	74	22.6
Urinary tract infection		
0 times/year	65	19.9
0＜times/year≤2	174	53.2
2＜times/year	88	26.9
Types of catheters		
Non-hydrophilic-coated catheters	192	58.7
Single-use hydrophilic-coated catheters	72	22.0
Pre-lubricated single-use gel catheters	36	11.0
Reusable catheters	27	8.3
ISC training		
Yes	183	56.0
No	144	44.0
ISC follow-up		
Yes	87	26.6
No	240	73.4
Province		
Hubei	64	19.6
Henan	66	20.2
Sichuan	70	21.4
Anhui	62	19.0
Guangdong	65	19.0

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Table 2. The relationship between the independent variables and I-CAT scores(*n*=327).

Variables	Total score	Multiple fears	Global question
Age (year)	-0.086	-0.081	-0.047
Gender	0.052	0.018	0.048
Marital status	0.002	-0.001	-0.031
Occupation	0.012	-0.020	0.025
Family residence	0.051	0.025	0.081
Personal monthly income (RMB)[c]	0.076	0.079	0.009
Education level	0.024	0.020	-0.005
Medical expenses payment method	-0.015	-0.053	-0.016
Residential living arrangements	0.065	0.031	0.024
Duration of carrying out ISC	-0.087	-0.073	-0.119*
Urinary tract infection	0.032	0.046	0.014
Types of catheters	-.0538**	-0.490**	-0.431**
ISC training	0.861**	0.754**	0.683**
ISC follow-up	0.766**	0.702**	0.620**
Province	-0.506**	-0.465**	-0.656**
InCaSaQ	0.100	0.066	0.057
Packaging	0.147**	0.102	0.089
Lubrication	0.105	0.088	0.049
Catheter itself	0.050	0.025	0.020
After catheterization	0.012	0.004	0.027
ICDQ	0.341**	0.323**	0.296**
Intensity	0.320**	0.310**	0.284**
Frequency	0.342**	0.317**	0.290**
ISC-Q	-0.551**	-0.500**	-0.444**
Ease of use	-0.288**	-0.324**	-0.264**
Convenience	-0.574**	-0.530**	-0.438**
Privacy	0.068	0.071	0.048
Psychological well-being	-0.774**	-0.697**	-0.625**

Note: [c]1 EUR = 7.79RMB; NLUTD, Neurogenic Lower Urinary Tract Dysfunction; ISC, Intermittent self-catheterization; InCaSaQ, Intermittent catheterization satisfaction questionnaire; ICDQ, Intermittent catheterization difficulty questionnaire; ISC-Q, Intermittent self-catheterization questionnaire; I-CAT,

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641 **Table 3.** Factors influencing I-CAT scores among NLUTD patients by multiple linear regressions analysis(n=307).

Variables	*B*	SE	*β*	*t*	*P* value	95% CI for *B*		VIF
						Lower	Upper	
Constant	37.028	1.822		20.32	0.000	33.443	40.614	
Education level								
Primary schools	Reference category	-	-	-	-	-	-	-
Junior high school	-1.002	0.54	-0.04	-1.856	0.064	-2.065	0.06	1.035
Urinary tract infection								
0 times/year	Reference category	-	-	-	-	-	-	
0＜times/year≤2	-0.905	0.45	-0.043	-2.01	0.045	-1.79	-0.019	1.022
Types of catheters				0.034				
Non-hydrophilic-coated catheters	Reference category	-	-	-	-	-	-	
Single-use hydrophilic-coated catheters	-4.409	1.062	-0.173	-4.153	0.000	-6.498	-2.32	3.92
Pre-lubricated single-use gel catheters	-3.132	1.14	-0.093	-2.747	0.006	-5.375	-0.889	2.579
ISC training								
Yes	Reference category	-	-	-	-	-	-	-
No	6.984	0.657	0.329	10.638	0.000	5.692	8.276	2.152
ISC follow-up support								
Yes	Reference category	-	-	-	-	-	-	-
No	6.759	1.027	0.283	6.584	0.000	4.739	8.779	4.169

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Province									
	Hubei =1	Reference category	-	-	-	-	-	-	-
	Henan	-4.480	0.79	-0.171	-5.672	0.000	-6.034	-2.926	2.036
	Sichuan	-3.885	0.717	-0.151	-5.417	0.000	-5.296	-2.474	1.753
	Anhui	-5.611	0.757	-0.209	-7.41	0.000	-7.101	-4.121	1.785
	Guangdong	-6.195	0.869	-0.235	-7.13	0.000	-7.904	-4.485	2.435
ISC-Q		-0.206	0.03	-0.192	-6.931	0.000	-0.264	-0.147	1.729
InCaSaQ		0.417	0.069	0.148	6.073	0.000	0.282	0.552	1.341

642 ***Note:*** R^2=0.861,adjusted R^2=0.855,F=161.409, P<0.001. B, partial regression coefficient for the constant. SE, the standard error around the coefficient for the constant. β,
643 standard partial regression coefficient.NLUTD, Neurogenic Lower Urinary Tract Dysfunction. I-CAT, Intermittent catheterization acceptance test. ISC-Q, Intermittent
644 self-catheterization questionnaire.InCaSaQ, Intermittent catheterization satisfaction questionnaire.
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Note: ᶜ1 EUR = 7.79RMB; NLUTD, Neurogenic Lower Urinary Tract Dysfunction; ISC, Intermittent self-catheterization; I-CAT, Intermittent catheterization acceptance test; SD, Standard deviation.

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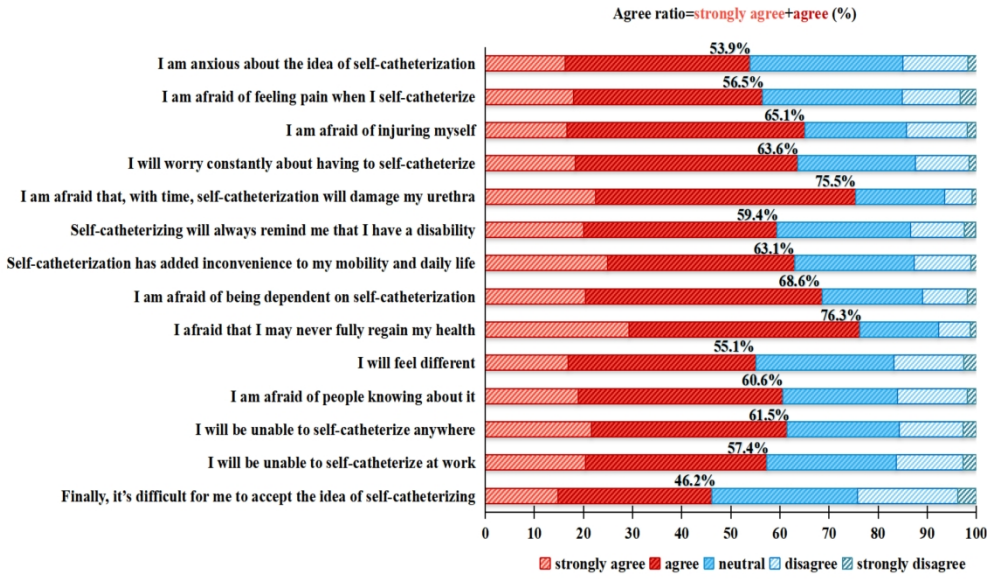

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Urinary tract infection								
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0＜times/year≤2	-0.905	0.45	-0.043	-2.01	0.046	-1.79	-0.019	1.022
Types of catheters				0.034				
Non-hydrophilic-coated catheters	Reference category	-	-	-		-	-	
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ISC training								
Yes	Reference category	-	-	-		-	-	-
No	6.984	0.657	0.329	10.638	0.000	5.692	8.276	2.152
ISC follow-up support								
Yes	Reference category	-	-	-	-	-	-	-
No	6.759	1.027	0.283	6.584	0.000	4.739	8.779	4.169
Province								
Hubei =1	Reference category	-	-	-	-	-	-	-

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	Henan	-4.480	0.79	-0.171	-5.672	0.000	-6.034	-2.926	2.036
	Sichuan	-3.885	0.717	-0.151	-5.417	0.000	-5.296	-2.474	1.753
	Anhui	-5.611	0.757	-0.209	-7.41	0.000	-7.101	-4.121	1.785
	Guangdong	-6.195	0.869	-0.235	-7.13	0.000	-7.904	-4.485	2.435
ISC-Q		-0.206	0.03	-0.192	-6.931	0.000	-0.264	-0.147	1.729
InCaSaQ		0.417	0.069	0.148	6.073	0.000	0.282	0.552	1.341

Note:R^2=0.861,adjusted R^2=0.855,F=161.409, P<0.001. *B*, partial regression coefficient for the constant. SE, the standard error around the coefficient for the constant. β, standard partial regression coefficient.NLUTD, Neurogenic Lower Urinary Tract Dysfunction. I-CAT, Intermittent catheterization acceptance test. ISC-Q, Intermittent self-catheterization questionnaire.InCaSaQ, Intermittent catheterization satisfaction questionnaire.

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Supplemental table 1. STROBE Statement—Checklist of items that should be included in reports of cross-sectional studies.

Section/Topic	Item	Checklist Item	Reported on Page #.
Title and abstract			
	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	#1 Title
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	#2-3 Abstract
Introduction			
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	#4 Introduction, 1st to 2rd paragraphs
Objectives	3	State specific objectives, including any prespecified hypotheses	#4 Introduction,3rd paragraph
Methods			
Study design	4	Present key elements of study design early in the paper	# 5 Methods, Study design and participants
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	# 5-6 Methods, Study design and participants, and data collection procedure
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	# 5 Methods, Study design and participants
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	# 6-8 Methods, I-CAT, InCaSaQ, ICDQ, and ICDQ
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	# 8 Methods, Data analysis
Bias	9	Describe any efforts to address potential sources of bias	# 5-6 Methods, Data collection procedure
Study size	10	Explain how the study size was arrived at	# 6 Methods, Sampling
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	# 8 Methods, Data analysis
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	# 8 Methods, Data analysis
		(*b*) Describe any methods used to examine subgroups and interactions	Not applicable
		(*c*) Explain how missing data were addressed	Not applicable
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(*e*) Describe any sensitivity analyses	Not applicable
Results			

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	# 8-9 Results, Participant characteristics and appendix_4
		(b) Give reasons for non-participation at each stage	Not applicable
		(c) Consider use of a flow diagram	Not applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1
		(b) Indicate number of participants with missing data for each variable of interest	#8-9Results,Participant characteristics in Table 1
Outcome data	15*	Report numbers of outcome events or summary measures	Not applicable
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Not applicable
		(*b*) Report category boundaries when continuous variables were categorized	Not applicable
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Not applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	# 11 Discussion,1rd paragraph
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	#14-16 Discussion,8st to 10rd paragraphs
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	# 11-14 Discussion,2st to 7rd paragraphs
Generalisability	21	Discuss the generalisability (external validity) of the study results	# 16, Conclusions
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	# Title page

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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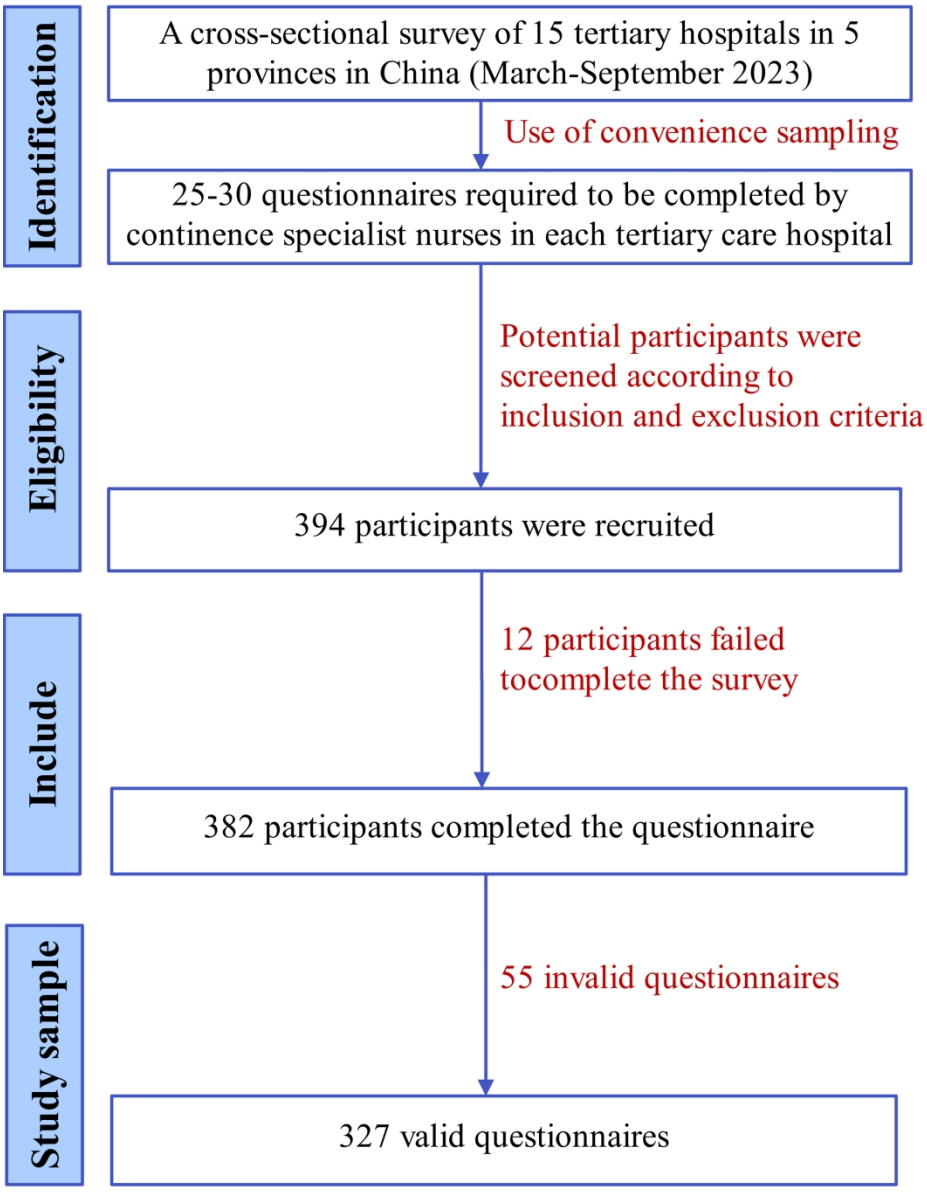

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Supplemental table 2. Assigned values of independent variables.

Variables	Description/Recoding
Age (year)	18＜years≤35=1, 35＜years≤45=2, 45＜years≤65=3
Gender	Male=1,Women=2
Marital status	Unmarried=1, Married=2, Divorced=3
Occupation	Unemployed=1, Employed=2
Family residence	City=1,Town=2,Countryside=3
Personal monthly income (RMB)[c]	≤3000=1, ＞3000=2
Education level	Primary schools=1, Junior high school=2, Senior high school=3, Bachelor's degree and above=4
Medical expenses payment method	Self-paid=1, Medical insurance=2, Work-related injury insurance=3, Others=4
Residential living arrangements	Solo living=1, Co-inhabiting with one individual=2, Living with two to three individuals=3, Living with four to six individuals=4
Duration of carrying out ISC	0＜years ≤ 1=1, 1＜years ≤5=2, 5＜years=3
Urinary tract infection	0 times/year=1, 0＜times/year≤2=2, 2＜times/year=3
Types of catheters	Non-hydrophilic-coated catheters=1, Single-use hydrophilic-coated catheters=2, Pre-lubricated single-use gel catheters=3, Reusable catheters=4
ISC training	Yes=1, No=2
ISC follow-up	Yes=1, No=2
Province	Hubei =1, Henan =2, Sichuan =3, Anhui =4, Guangdong =5

Note: [c]1 EUR = 7.79RMB; ISC follow-up support (including face-to-face communication, telephone communication, home visits, online educational platforms, and text messages)

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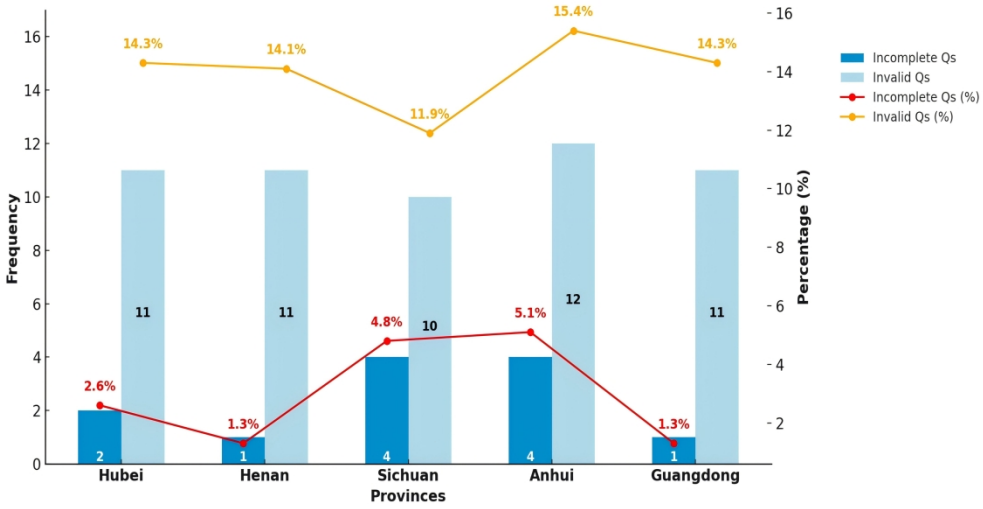

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Supplemental table 3. Sample distribution status.

ID	Province	Hospital Name	Target number of Qs (*n*=375-450)	Incomplete Qs (*n*=12) %	Invalid Qs (*n*=55) %	Valid Qs (*n*=327) %	Collected Qs (*n*=394) %
1	Guangdong	The University of Hong Kong-Shen Zhen Hospital	25-30	1 (8.3)	3（5.5）	22 (6.7)	26 (6.6)
2		Shenzhen Bao' an District People's Hospital	25-30	0 (0.0)	5（9.0）	21 (6.5)	26 (6.6)
3		Shenzhen Hospital, Southern Medical University	25-30	0 (0.0)	3（5.5）	22 (6.7)	25 (6.3)
Guangdong Total			75-90	1 (8.3%)	11（20.0）	65 (19.9%)	77 (19.5%)
4	Sichuan	Mianzhu City People's Hospital	25-30	3 (25.1)	4（7.3）	20 (6.1)	27 (6.9)
5		Sichuan Provincial People's Hospital	25-30	1 (8.3)	3（5.5）	24 (7.3)	28 (7.1)
6		Deyang People's Hospital	25-30	0 (0.0)	3（5.5）	26 (8.0)	29 (7.5)
Sichuan Total			75-90	4 (33.4%)	10（18.3）	70 (21.4%)	84 (21.5)
7	Hubei	Zhongnan Hospital of Wuhan University	25-30	1 (8.3)	4（7.3）	20 (6.1)	25 (6.3)
8		Jingzhou First People's Hospital	25-30	0 (0.0)	4（7.3）	21 (6.5)	25 (6.3)
9		Xiangyang Central Hospital	25-30	1 (8.3)	3（5.5）	23 (7.0)	27 (6.9)
Hubei Total			75-90	2 (16.6%)	11（20.1）	64 (19.6%)	77 (19.5%)
10	Anhui	The First Affiliated Hospital of Anhui Medical University	25-30	2 (16.7)	3（5.5）	23 (7.0)	28 (7.1)
11		The Second Affiliated Hospital of Wannan Medical College	25-30	2 (16.7)	4（7.3）	19 (5.8)	25 (6.3)
12		The First Affiliated Hospital of the University of Science and Technology of China	25-30	0 (0.0)	5（9.0）	20 (6.1)	25 (6.3)
Anhui Total			75-90	4 (33.4%)	12（21.8）	62 (18.9%)	78 (19.7%)
13	Henan	The First Affiliated Hospital of Zhengzhou University	25-30	1 (8.3)	2（3.5）	22 (6.7)	25 (6.3)
14		Henan Provincial People's Hospita	25-30	0 (0.0)	4（7.3）	23 (7.0)	27 (6.9)
15		Luoyang Central Hospital	25-30	0 (0.0)	5（9.0）	21 (6.5)	26 (6.6)
Henan Total			75-90	1 (8.3%)	11（19.8）	66 (20.2%)	78 (19.8%)

Note: The χ^2 test was used to evaluate differences in questionnaire completion status (including incomplete, invalid, and valid responses) across provinces. Results showed no significant differences in the distribution of incomplete and invalid questionnaires among provinces (χ^2=4.08, *P*=0.85). However, due to the small sample size in each hospital (25-30 questionnaires), the χ^2 test was not used to assess completion status differences across hospitals.

Abbreviations: Qs, Questionnaires.

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Acceptance and the influencing factors towards intermittent self-catheterization among patients with neurogenic lower urinary tract dysfunction in China: a multi-centers cross-sectional study

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Note: RN,Registered Nurse; RT,Registered Therapist; MN,Master of Nursing; BN,Bachelor of Nursing; PhD,Doctor of Philosophy.

Contributors

Ling Chen and Wenzhi Cai developed the research methodology, with Laifu Wang and Dan Wu conducting the investigation. Data analysis was led by Fengming Hao, Yingjie Hu, and Senying Luo, while the original draft was prepared by Fengming Hao and Yingjie Hu. Senying Luo, Fengming Hao, and Yingjie Hu also contributed to the review and editing process under the supervision of Ling Chen and Wenzhi Cai. The overall responsibility, including resources and funding acquisition, was managed by Wenzhi Cai, who also served as the guarantor for this work.

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Competing interests

The authors declared no conflict of interest.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Provenance and peer review

Not commissioned; externally peer reviewed.

Data availability statement

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics statements

Not applicable.

Commented [胡 1]: we have made revisions. The original wording was inaccurate, and it has now been updated to "Not applicable."

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Ethics approval

All participating centers in this study adhered to ethical standards, with the research conducted under the approval of the Medical Ethics Committee of the lead institution, Shenzhen Hospital, Southern Medical University (Approval No. NYSZYYEC20230031). This approval was recognized and accepted by all other participating hospitals. Each center conducted patient recruitment and data collection in compliance with the approved ethical guidelines. All participants provided electronic informed consent and voluntarily completed the online survey. Additionally, all information obtained from the participants is strictly confidential and anonymized.

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