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Wei Li
People's Hospital of Leshan
jie Yang
People's Hospital of Leshan
li jun wang
People's Hospital of Leshan
li zhou
People's Hospital of Leshan
fengjiao xu
People's Hospital of Leshan
hui xiong
People's Hospital of Leshan
xin zhao
People's Hospital of Leshan
guojun Zeng
People's Hospital of Leshan
zehua lei
leitsehua@126.com

People's Hospital of Leshan

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Original Article

Development and Factorial Structure of the Surgical Patient's Anxious Condition Assessment Scale (SPAC)

Wei Li[a,c,1], Jie Yang[a,b,1], Lijun Wang[a,c], Li Zhou[a], Fengjiao Xu[a,b], Hui Xiong[a,b],Xin Zhao[a,b],Guojun Zeng[d,*] ,Zehua Lei[a,b,*]

a.LEER Model Enhanced Recovery after Surgery Clinical Application Center,The Leshan People's Hospital, Leshan, Sichuan 614000, China;
b.Department of Hepatobiliary and Pancreatic Surgery,The Leshan People's Hospital, Leshan, Sichuan 614000, China;
c. Colon and Rectal Surgery,the Leshan People's Hospital, Leshan, Sichuan 614000, China
d.Department of Vascular Surgery, West China Hospital, Sichuan University,Chengduo, Sichuan 614000, China;

[*]**Corresponding author:** Lei Zehua

Department of Hepatobiliary and Pancreatic Surgery,The Leshan People's Hospital, Leshan, Sichuan 614000, China，E-mail: leitsehua@126.com.

***Co-Corresponding author:** Guojun Zeng

Department of Vascular Surgery, West China Hospital, Sichuan University,Chengduo, Sichuan 614000, China,E-Mail: zengguojun@wchscu.cn.

Abstract

Objective:

The objective was to develop the Surgical Patient's Anxious Condition Assessment Scale (SPAC) to provide evidence supporting clinical non-pharmacological interventions.

Methods:

A qualitative study was conducted at Leshan People's Hospital in Sichuan Province, China. Semi-structured interviews were carried out with 11 patients to create an item pool for the scale. This was followed by a Delphi expert inquiry (N=16) and a pilot test (N=30), with subsequent adjustments to the scale based on patient feedback. Surgical inpatients from the same hospital were surveyed using the scale, and an exploratory factor analysis (EFA) was performed on a random sample (N=376). A confirmatory factor analysis (CFA) was conducted on a second sample (N=386).

Results:

The finalized SPAC Assessment Scale included three dimensions: medical provider, process and effect, and hospital environment, comprising a total of ten items. The overall Cronbach's alpha coefficient was 0.893. The EFA revealed a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of 0.892 and a Bartlett's Test of Sphericity, which yielded a chi-square value of 2886.217, df=45, $p<0.001$. Principal Component Analysis (PCA) identified three common factors, accounting for 63.20% of the cumulative variance. The rotated factor structure was distinct, with each item demonstrating high loadings (>0.7) on its respective factor and minimal cross-loading. The CFA results indicated a chi-square/degrees of freedom ratio of 2.87, a Comparative Fit Index (CFI) of 0.942, a Tucker-Lewis Index (TLI) of 0.928, a Root Mean Square Error of Approximation (RMSEA) of 0.078, and a Standardized Root Mean Square Residual (SRMR) of 0.048, confirming a very good fit of the three-factor model to the data.
Conclusion:
The SPAC assessment scale exhibits excellent factorial validity and internal consistency. It provides a reliable clinical tool for identifying and addressing anxiety among surgical patients, facilitating standardized perioperative psychological management.

Keywords: Psychometrics, Anxiety, Surgical Procedures, Operative, Reproducibility of Results

Introduction

Surgical interventions, as pivotal medical procedures, typically provoke substantial psychological stress responses in patients undergoing treatment for various ailments. Factors contributing to this stress include surgical trauma, the risks associated with anesthesia, postoperative pain, and the reliability of postoperative medical support. These elements frequently engender feelings of worry, tension, and fear among patients[1-3]. Research[4] has shown that preoperative anxiety not only undermines patient compliance and surgical safety but also prolongs the recovery period and escalates the risk of complications. Presently, psychological assessments for surgical patients primarily utilize established, gold-standard instruments designed to measure anxiety and depression. While these instruments are adept at identifying clinical endpoints, such as fully developed anxiety disorders, their dichotomous nature (pathological vs. non-pathological) may limit their sensitivity to the specific "anxious state" induced by the surgical experience. This limitation can lead to the oversight of clinically

significant yet subthreshold emotional disturbances[5], which, although they do not meet the full diagnostic criteria, still impair recovery and quality of life.

Currently, psychological assessments for surgical patients often employ general scales or established tools. For example, the Amsterdam Preoperative Anxiety and Information Scale (APAIS)[6] is an internationally recognized assessment tool specifically tailored for surgical contexts. However, its primary focus on information-seeking behaviors and its concise format may not sufficiently capture the "intermediate state" we aim to define, namely, "worry-related emotions". Additionally, the effectiveness of this scale may be influenced by cultural variations in expressing surgical anxiety. In our local clinical setting, the Huaxi Emotional Distress Index (HEI)[7], a brief screening tool developed for the rapid identification of emotional distress in general hospital patients, is extensively used due to its operational efficiency. Nevertheless, during its hospital-wide implementation, it was observed[8] that the HEI classified 96.3% of general surgery patients as having no or mild emotional distress. Although these patients were clinically categorized as "psychologically normal," clinical practice revealed that they actually experienced varying degrees of psychological stress. This high rate of missed diagnoses does not solely reflect the shortcomings of individual tools but serves as a broader warning signal. Whether it be universal international scales, specialized surgical tools like APAIS, or local screening tools such as HEI, existing assessment methods fail to adequately identify specific subclinical "anxiety states" that differ from routine preoperative concerns and fully manifested clinical anxiety. This gap underscores the necessity of developing and validating context-sensitive tools, such as the SPAC scale.

The accurate assessment of psychological states presents a significant challenge in the fields of clinical psychology and mental health services[9]. Delayed intervention can greatly exacerbate the risk of negative emotional outcomes during hospitalization, subsequently affecting the postoperative recovery and prognosis of patients. The identification of "anxious conditions" during the perioperative period in surgical patients, coupled with the implementation of a non-pharmacological psychological management model, is now a critical concern within surgical systems. The development of the SPAC scale addresses this urgent clinical need. This tool was developed following a standardized process, drawing its conceptual foundation from the "reassurance" element integral to the Enhanced Recovery After Surgery (ERAS) protocols, an internationally recognized perioperative care framework. This concept was further operationalized through the LEER model (Less Pain, Early Movement, Early Eating, Reassurance), a patient-centered psychological support initiative implemented at the People's

Hospital of Leshan City, Sichuan, China[10]. The conceptual framework was constructed through a literature review and in-depth interviews, followed by item selection via expert consultations and cognitive interviews, and finally validated through a large-scale survey to ensure reliability and validity, culminating in a concise and reliable clinical assessment tool.

Methods

SPAC Assessment Scale Item Pool

Theoretical Basis

The theoretical foundation of this study is derived from one of the core objectives of ERAS within the LEER model, specifically the "reassuring" aspect. This component is designed to facilitate the implementation of the ERAS philosophy through the establishment of systematic, standardized methods and workflows[10].

Entry pool formation

Following a preliminary literature review[11-16], qualitative research utilizing semi-structured interviews, and consultation of psychological assessment scales from both domestic and international sources[17,18], combined with brainstorming sessions within the research team, a preliminary item pool for the SPAC assessment scale was developed.

Qualitative Research

Research Subjects

Using convenience sampling, surgical patients admitted to the Hepato-Biliary-Pancreatic Surgery Department at the People's Hospital of Leshan City between August 2024 and April 2025 were selected as subjects for qualitative research.All procedures involving human participants in this study were conducted in accordance with the ethical principles of the Declaration of Helsinki and received academic review approval from the Ethics Committee of Leshan People's Hospital (LYLL[2023]KY032). All patients provided informed consent and participated voluntarily in the investigation.

(1) Inclusion and Exclusion Criteria for Participants

Inclusion criteria included: (i) possessing normal communication abilities; (ii) being informed and consenting to participate in the study; (iii) patients hospitalized for surgical diseases scheduled for surgery.

Exclusion criteria were: (i) a history of psychiatric illness; (ii) inability to communicate or presence of communication barriers; (iii) individuals under the age of 18. Criteria for removal from the study included: (i) patients who were discharged without undergoing surgery for

various reasons; (ii) deceased patients. Sampling continued until data saturation was reached, indicated by the repetitive emergence of data and the absence of new themes during analysis. Ultimately, 11 participants were included in the study. The participants were coded with numbers to protect their privacy, as detailed in Table 1.

(2) Criteria for Selection of Interview Researchers

The preliminary interview researchers were selected based on having at least ten years of experience in surgical nursing and holding managerial positions. The formal interviews were conducted by researchers who were master's degree students in nursing. Those meeting these criteria were permitted to conduct qualitative interviews.

Table 1 General information of respondents (N=11)

Number	Gender	Age	Marital status	Academic qualifications	Occupation	Admission Diagnosis
P1	Male	70	Married	Elementary	Retired	Gallstones, Pancreatitis
P2	Female	50	Married	Junior High	Freelancer	Gallstones
P3	Female	28	Married	University	Freelancer	Gallstones
P4	Female	48	Married	High School	Clerk	Gallstones
P5	Female	62	Married	Illiterate	Farmer	Gallstones
P6	Female	73	Married	Elementary	Retired	Gallstones
P7	Female	29	Married	University	Clerk	Gallstones, Pancreatitis
P8	Male	45	Married	High School	Clerk	Gallstones
P9	Female	44	Married	Elementary	Freelancer	Gallstones
P10	Male	53	Married	Illiterate	Farmer	Gallstones
P11	Female	37	Married	High School	Worker	Gallstones

Data Collection and Quality Control

Utilizing a phenomenological approach[19], the study executed face-to-face, in-depth interviews with respondents. Researchers accessed medical records and consulted supervising physicians to gather pertinent information about the respondents prior to the interviews, which were conducted on the day of admission in a private space to ensure a quiet, undisturbed environment. Prior to commencing the interview, researchers introduced themselves to the respondents, informed them of the objectives and significance of the research, and pledged strict adherence to confidentiality and anonymity principles, also notifying that the proceedings would be recorded. With the respondents' informed consent, the interviews were initiated. During the interviews, researchers were careful not to lead or interrupt the respondents' train of

thought unduly, encouraged them to express their genuine feelings and experiences, and observed non-verbal behaviors, noting alterations in facial expressions, tone, and emotional state. Researchers could adjust the manner and sequence of questioning based on situational needs, aiming to gather information and ensure that the interview remained focused on the topic. The duration of each interview was controlled to be between 20 to 25 minutes per individual.

To ensure consistency and standardization throughout the data collection process, several measures were implemented. First, interviewers underwent two days of systematic training. Second, the project lead observed and provided real-time guidance during each interviewer's first two sessions. Finally, during the data collection phase, weekly meetings were held to discuss issues promptly and adjust methodologies, thus ensuring consistent and stable interview quality.

Translation/Language Process

A standard forward-backward translation process was employed to ensure the accuracy of the English version of the project.

Data Analysis Methods

Post-interview, the researchers transcribed the recorded audio and notes into textual material and repeatedly verified the accuracy of the transcription. Non-verbal data recorded during the interviews were also integrated into the corresponding sections of the text. All interview data were coded and analyzed using NVivo 12.0. The data were organized according to the seven-step analysis method of Colaizzi[20], with two master's degree students in nursing responsible for the sorting, analyzing, and categorizing of interview data, culminating in the synthesis of themes. In cases of discrepancies during the dual analysis process, a third party would make a decision or consult the respondents for verification to ensure the authenticity and correctness of the data.

Delphi Expert Inquiry

Selection Criteria for Experts

To ensure the authority, scientific integrity, and avoidance of single-perspective bias in the SPAC scale, the research team employed the Delphi expert inquiry method[21]. A total of seventeen experts were selected for the inquiry. The inclusion criteria for the experts were as follows: (1) research fields in hospital management, clinical psychology, psychology, public health, clinical surgery, or clinical nursing; (2) a minimum educational qualification of an undergraduate degree; (3) holding at least a senior associate professional title; (4) a minimum

of ten years of relevant professional experience; and (5) a positive attitude towards the research, with a willingness to participate in at least two rounds of the Delphi inquiry. The criteria for excluding experts included: (1) inability to return feedback on time, and (2) inability to continue the inquiry for various reasons. The criteria for selecting items based on the inquiry results were: an item's mean importance assignment greater than 3.5, a coefficient of variation (CV) less than 0.25, and a full score ratio of at least 20% for the items. The inquiry was concluded when expert opinions converged, and items meeting these criteria were included in the draft version of the SPAC scale.

Drafting the Delphi Inquiry Questionnaire

The Delphi inquiry method was utilized to review the initial item pool of the SPAC scale. The inquiry form consisted of three parts: (1) a letter to the experts briefly outlining the purpose and significance of developing the SPAC scale; (2) an evaluation of the applicability and importance of each item on the questionnaire; and (3) a survey of basic information about the experts and their familiarity with and basis for judgment on the inquiry content. Each item's importance and feasibility were rated using a Likert five-point scale[22], combined with the experts' theoretical knowledge and practical experience.

Preliminary Survey and Reintegration of Items

To examine the appropriateness and practicality of the draft version of the SPAC scale, a preliminary survey was conducted in May 2025 with thirty patients admitted to the hepatobiliary surgery department at People's Hospital of Leshan City. The research team members explained the purpose and significance of the study to the patients and obtained their consent before initiating the survey. The inclusion, exclusion, and elimination criteria for patients were aligned with those used in qualitative research. Based on the results of the preliminary survey, the items were integrated and optimized. The final version of the SPAC scale was then determined through an evaluation of content validity.

Survey Methodology

A convenience sampling of inpatients within the surgical department at the People's Hospital of Leshan City was conducted from June to September 2025, employing the same inclusion and exclusion criteria as the preliminary survey. The survey utilized the SPAC scale, with researchers trained uniformly by the scientific team before undertaking the survey and data collection. Scales were distributed and collected on-site, with checks for over-completion, omissions, and errors. Any issues detected were promptly communicated to the patients for

amendment and supplementation. Data entry was performed by nursing master's degree students and was double-checked to ensure its authenticity and accuracy.

Defending the 3-Point Scale

The SPAC scale employs a three-point Likert scale. This simplified format is deliberately adopted to reduce the cognitive burden on hospitalized patients and enhance assessment efficiency, thereby improving the tool's practicality and completion rate in clinical settings.

Statistical Methods

Survey data were double-checked and entered into Excel 2019, followed by statistical analysis using SPSS 25.0 and Amos 24.0. Quantitative data adhering to a normal distribution were presented as mean±standard deviation ($\bar{x}\pm s$), while qualitative data were expressed in frequencies and percentages (%). The degree of expert engagement was calculated as the number of valid questionnaires divided by the total distributed, multiplied by 100%; expert authority was determined by Cr=(Cs + Ca)/2. The concentration of expert opinions was represented by the mean importance assignment (mj), CV, and the full score ratio; concordance among experts was measured by Kendall's coefficient of concordance (W). EFA and CFA were employed to assess the structural validity of the scale. Reliability was evaluated using Cronbach's alpha, split-half reliability, and test-retest reliability.

（1）Structural Validity Analysis: In Sample 1 (N1=376), an EFA was conducted using PCA with varimax rotation. Common factors were extracted based on eigenvalues greater than 1, with a criterion for retention set at a cumulative variance contribution greater than 50% and factor loadings of ≥0.400. Items with cross-loadings greater than 0.400 on two or more factors and a difference of less than 0.200 were removed. Reliability analysis was performed using a Cronbach's α greater than 0.70, and the scale's overall reliability was further validated with split-half and test-retest reliability, the latter reassessed seven days later.

（2）Confirmatory Factor Analysis (CFA): In Sample 2 (N2=386), CFA tested standard metrics including $\chi 2/df<3$, CFI>0.9, TLI>0.9, and RMSEA<0.08, with significance set at P<0.05.

Results

The development of the SPAC scale revealed discrepancies between the theoretically postulated dimensions (four dimensions) and the actual data analysis results (three dimensions), with the analysis failing to substantiate an independent "disease" dimension. Based on the current data, the research team will consider adopting a three-factor model (three dimensions,

ten items in total). The specific results of the research and development process are detailed as follows.

Results of the Delphi Inquiry

The Delphi inquiry included 17 experts from medical institutions and related organizations across several regions including Sichuan Province, Hubei Province, Inner Mongolia Autonomous Region, Guangxi Zhuang Autonomous Region, Shanghai, Guangdong Province, Zhejiang Province, and Chongqing City. The average age of these experts was 48.64 years with a standard deviation of 6.45. The composition of the experts was as follows: 12 non-graduate supervisors (70.59%), 2 master's degree student supervisors (11.76%), and 3 doctoral student supervisors (17.65%). Detailed baseline data for the experts is provided in Table 2. The effective response rate for two rounds of expert inquiry was 100%. In the first round, 15 experts (93.75%) suggested modifications; in the second round, 11 experts (64.70%) made suggestions. The authority coefficients (Cr) for the first and second rounds of inquiry were 0.89 and 0.84, respectively, both exceeding 0.8, indicating a high level of expert authority and reliability of the results. The mean importance assignment scores for the SPAC assessment scale items in the first round ranged from 3.52 to 4.88, with CV ranging from 0.080 to 0.382 and full score ratios ranging from 0.23 to 0.94. In the second round, mean importance assignment scores ranged from 4.05 to 5, CVs from 0 to 0.298, and full score ratios from 0.47 to 1, indicating high levels of expert agreement on the items. Kendall's W coefficient of concordance, which measures the degree of consensus among experts, ranged from 0 to 1. Higher values indicate greater reliability and concordance of expert opinions. The coefficients for the two rounds of inquiry were 0.187 and 0.235 (both $P<0.05$), indicating significant disagreement on certain items. For these contentious items, our team conducted a comprehensive analysis incorporating group brainstorming and clinical experience, leading to the deletion or modification of certain items in the scale.

During the first round of inquiry, a subset of experts proposed 16 amendments to the questionnaire items. After reviewing relevant literature and engaging in comprehensive discussions, selective adaptations were made: 7 items were removed, and the phrasing of 16 items was altered. Notably, in the second round of expert inquiry, the experts suggested 10 further modifications, indicating that the initial revisions were indeed effective and validated. The consensus among experts regarding the validity and feasibility of the survey content was achieved, allowing its subsequent application in related studies and leading to the development of a preliminary version of the SPAC assessment scale.

Table 2: Baseline Information of Delphi Inquiry Experts (N=17)

Project	Grouping	（%）
Gender	Male	11（64.7）
	Female	6（35.2）
Academic qualifications	Bachelor’s degree	7（41.1）
	Master’s degree	6（35.2）
	Doctoral	4（23.5）
Professional title	Associate senior	6（35.2）
	Senior	11（64.7）
Years of service	＜10 years	1（5.8）
	10~20 years	4（23.5）
	21~30 years	7（41.1）
	＞30 years	5（29.4）

Preliminary Survey Results and Item Reintegration

Our team employed the preliminary version of the SPAC scale for an initial pre-survey (n=5), during which several issues emerged. The survey revealed numerous repetitive items, and patients were either unable to comprehend or accurately understand the statements, raising many questions. The formal language used in the item descriptions proved impractical, with each patient interview exceeding 20 minutes. In clinical practice, there is a pressing need for clarity, simplicity, and easily understandable scales. Consequently, our team consolidated repetitive items and provided more specific descriptions, simplifying the scale to the greatest extent possible while ensuring a comprehensive assessment. This process resulted in the creation of version 1.0 of the SPAC assessment scale. Employing the SPAC assessment scale version 1.0 in a subsequent pre-survey (n=30) revealed that patients could understand the items, found no redundancies, and completed the scale in less than 3 minutes, with no modifications or additions suggested by the respondents.

Evaluation of Content Validity for the Prototype Item of the SPAC Scale

To assess whether Version 1.0 of the SPAC scale prototype could scientifically and effectively measure an individual’s anxious condition, an expert inquiry was conducted involving six specialists who utilized a Likert 5-point scoring method to evaluate the content validity of the scale. This evaluation included aspects such as relevance, representativeness, clarity, and necessity. The results indicated that the item-level content validity index (I-CVI) ranged from 0.83 to 1.00, all exceeding the threshold of 0.78, and the scale-level content validity

index (S-CVI) was 0.93, surpassing the minimum standard of 0.80. These findings suggest that Version 1.0 of the SPAC scale prototype still encompasses the core constructs. Consequently, Version 1.0 of the SPAC scale prototype has been adopted as the official version of the SPAC assessment scale (V1.0), comprising four dimensions and ten items.

Structure and Content of the SPAC Scale

The finalized SPAC assessment scale is presented in Table 3. The SPAC scale utilizes a 3-point Likert scoring system, assigning scores from "not anxious" to "moderately anxious" to "extremely anxious," scored from 0 to 2 points respectively, with a total possible score ranging from 0 to 20 points. Higher scores indicate a more severe anxious condition in the patient. Based on the total score of the SPAC scale, anxiety is categorized into four levels: not anxious (0-5 points), mildly anxious (6-10 points), moderately anxious (11-15 points), and severely anxious (16-20 points).

Table 3 Structure and Content of the SPAC Scale

Name： Hospital admission number： year： Department： Telephone ：			
Please describe your emotional state during your hospital stay:			
Entry	**Score**		
	2 (Extremely anxious)	1 Anxious	0 Not anxious
1. Are you anxious about complications during surgery?			
2. Are you anxious about the effectiveness of anesthesia during surgery?			
3. Are you anxious about the placement of gastric or urinary catheters, or abdominal drains during surgery?			
4. Are you anxious about pain after surgery?			
5. Are you anxious that the scar from the surgery might affect your appearance?			
6. Are you anxious about the convenience of examinations during your hospital stay?			
7. Are you anxious about privacy breaches during examinations or nursing care?			
8. Are you anxious that a lengthy hospital stay might impact your work or personal life?			
9. Are you anxious about the high cost of hospitalization (especially out-of-pocket expenses)?			

10. Are you anxious about difficulties in contacting your doctor after discharge?			
Total score			
Assessment Grade	□Not anxious □Mildly anxious □Moderately anxious □Severely anxious		

*Please tick the corresponding score bracket
1. Assessment levels are divided into four categories: not anxious (0-5 points), mildly anxious (6-10 points), moderately anxious (11-15 points), and severely anxious (16-20 points).
2. Intervention suggestions: For not anxious, the patient exhibits no significant anxiety, and the psychological state is stable; for mildly anxious, there is slight anxiety, and basic psychological support is advised; for moderately anxious, significant anxiety is evident, requiring proactive counseling or intervention by healthcare providers; for severely anxious, extreme anxiety may impact treatment, necessitating immediate attention.

Note: SPAC stands for Surgical Patient Anxious Condition.

Examination of Validity and Reliability

Between June and July of 2025, a total of 376 valid questionnaires were collected (N1=376). The overall Cronbach's alpha coefficient was recorded at 0.893; the split-half reliability at 0.896; and the test-retest reliability, measured 14 days later, at 0.872. These statistics indicate a high degree of internal consistency and good reliability for the scale. EFA yielded a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy at 0.892 and a Bartlett's Test of Sphericity $\chi 2$ of 2886.217, df=45, $P<0.001$, demonstrating strong inter-variable correlations and suitability of the data for factor analysis. PCA was employed with Varimax rotation, extracting three common factors: process and efficacy, hospital environment and privacy, and medical provider and costs. These factors accounted for a cumulative variance contribution of 63.20%. The rotated factor structure was clear, with each item loading significantly (>0.7) on its respective factor and no significant cross-loadings, thus confirming the scale's robust construct validity as shown in Table 4. Furthermore, data analysis indicated that the items corresponding to the "disease" dimension did not aggregate under a single factor but were instead more strongly explained by other factors. Therefore, the results of the EFA suggest that the optimal structure of the SPAC scale may be a three-dimensional model rather than the initially hypothesized four-dimensional model. The "disease" dimension was not supported by the data.

Table 4 Rotated Structure Matrix of Common Factors Extracted from the SPAC Scale

Number	Item Content	Surgical Outcomes and Body Image	Hospital Environment	Healthcare Providers
Q1	Are you anxious about complications during surgery?	**0.838**	0.163	0.156

Q2	Are you anxious about the effectiveness of anesthesia during surgery?	**0.851**	0.147	0.173
Q3	Are you anxious about the placement of gastric or urinary catheters, or abdominal drains during surgery?	**0.824**	0.156	0.158
Q4	Are you anxious about pain after surgery?	**0.793**	0.180	0.195
Q5	Are you anxious that the scar from the surgery might affect your appearance?	**0.736**	0.182	0.226
Q6	Are you anxious about the convenience of examinations during your hospital stay?	0.170	**0.796**	0.178
Q7	Are you anxious about privacy breaches during examinations or nursing care?	0.149	**0.813**	0.165
Q8	Are you anxious that a lengthy hospital stay might impact your work or personal life?	0.181	**0.838**	0.180
Q9	Are you anxious about the high cost of hospitalization (especially out-of-pocket expenses)?	0.193	0.169	**0.824**
Q10	Are you anxious about difficulties in contacting your doctor after discharge?	0.156	0.16	**0.845**

CFA

A CFA was performed using AMOS 24.0, with a sample size of 387 (N2=387). The results indicated a satisfactory model fit, evidenced by a $\chi 2/df$ of 2.87, a Comparative Fit Index (CFI) of 0.942, a Tucker-Lewis Index (TLI) of 0.928, a Root Mean Square Error of Approximation (RMSEA) of 0.078 (90% CI [0.065, 0.079]), and a Standardized Root Mean Square Residual (SRMR) of 0.048 (Table 5). These values suggest a very good fit of the three-factor model to the observed data.

Table 5 CFA Results for the SPAC Scale

Indicator	Value	Judgement	Result
χ^2/df	2.87	＜3	good
CFI	0.942	＞0.9	good
TLI	0.928	＞0.9	good
RMSEA	0.078	＜0.08	good
SRMR	0.048	＜0.08	good

Discussion

Conceptual Clarification: Measuring Situational Worry vs. Clinical Anxiety

We explicitly position the SPAC as a measure of situational worry, the natural, transient emotional responses specific to the surgical experience, rather than a diagnostic tool for clinical anxiety disorders. We explain that while the items capture the cognitive dimension (worry), we retain the term “Anxiety” in the title for clinical utility, as it is the term commonly

used by surgeons and patients to describe these preoperative concerns.

Scientifically Rigorous SPAC Scale Construction Process

The construction process of the SPAC scale was conducted with scientific rigor to ensure its scientific validity. This study intricately combined the characteristics of surgical inpatients and adhered strictly to the standardized procedures for scale development. It integrated the "reassuring" concept of the LEER model with the specific psychological experiences of patients in the perioperative period. Initially, through qualitative research, an item pool for the SPAC assessment scale was developed, focusing on the authentic psychological experiences of the patients. Subsequent discussions by an expert panel and the Delphi expert inquiry process involved 17 experts from diverse fields including psychology, clinical psychology, public health, hospital management, clinical surgery, and clinical nursing. This process achieved unanimous certification of the item content's relevance to the profession and clinical accuracy, and it ensured the representativeness of the scale in screening the psychological states of patients within the surgical system. The two rounds of inquiries achieved a 100% effective response rate, with Cr of 0.89 and 0.84, respectively, both exceeding 0.8, indicating the high level of authoritative competence of the selected experts and the reliability of the results. Once the SPAC scale was developed, to enhance its scientific foundation, rationality, and practicality, the research team invited six experts from the initial inquiry phase to evaluate the content validity of the prototype scale. The results demonstrated that the integrated items still covered the core constructs and that the scale could accurately capture the essential dimensions of the "anxious condition" in surgical patients. Thus, the SPAC scale can assist medical staff in quickly identifying surgical patients with an "anxious condition" and, based on the assessment results, provide early personalized psychological care. This approach aims to improve doctor-patient communication, thereby preventing the exacerbation of negative emotions, reducing postoperative complications, and accelerating the recovery of surgical patients during the perioperative period.

High Reliability and Validity of the SPAC Scale

An EFA demonstrated a KMO measure of sampling adequacy of 0.892 and a significant Bartlett's test of sphericity ($P<0.001$), indicating substantial correlations among the variables and thus validating the factor analysis. The analysis extracted three common factors that accounted for a cumulative variance of 63.20%. The factor loadings for each item on the scale exceeded 0.70, suggesting a robust factor structure. The distinct factor structure of the SPAC scale corresponds to various concerns among surgical patients, including fears related to

surgical risks, apprehensions about the hospital environment, and concerns regarding medical costs and the sustainability of postoperative support. These dimensions are closely aligned with the theoretical constructs developed through qualitative research by the research team, highlighting the multifaceted nature of the "anxious condition" in this population. Moreover, there was a discrepancy between the theoretical anticipation of four dimensions and the empirical finding of three dimensions; notably, the analysis did not yield an independent "disease" dimension. It is hypothesized that concerns regarding "disease" are psychologically embedded within more tangible anxieties about economic costs and the impact on normal life, as perceived by the patients. From a psychological perspective, the "Surgical Outcomes and Body Image" factor relates to anxiety about medical threats, the "Hospital Environment" factor to environmental stressors, and the "Healthcare Providers" factor to anxieties about trust and communication. Based on current data, the research team is considering the adoption of this three-factor model, which comprises three dimensions and ten items.

CFA further validated the scale's structure, showing a $\chi 2/df$ of 2.87, a CFI of 0.942, a TLI of 0.928, a RMSEA of 0.078(90%*CI* [0.065, 0.079]), and a SRMR of 0.048. The overall Cronbach's alpha coefficient of 0.893, split-half reliability of 0.896, and test-retest reliability after 14 days of 0.872 indicated high internal consistency. Concerning content validity, the scale's I-CVI ranged from 0.83 to 1.00 and the S-CVI was 0.93, both surpassing the threshold of 0.80, confirming the scale's commendable content validity.

The SPAC scale demonstrates strong clinical applicability

In 2022, psychiatric expert Patrizia explicitly identified "worry" as a significant presence among patients[16,23], positing that "worry" serves as a precursor to states of anxiety and depression. "Worry" is manifested as a conscious and active response characterized by uncontrollable imaginings of the negative impacts of current situations. The essence of "worry" is an attempt to mitigate these negative impacts, thereby preventing them from triggering other negative emotions such as physical discomfort, restlessness, and irritability, which are symptomatic of generalized anxiety and depressive disorders. Conversely, when clinical healthcare providers overlook the excessive "worry" of patients, it may lead to the development of anxiety and depression among them. The quantification of psychological states is recognized as a healthy emotional regulation strategy[24]. Consequently, this study, developed under the LEER model of ERAS theories[25], introduces for the first time the concept of "SPAC," focusing deeply on the unique psychological plights of surgical patients. This breakthrough departs from traditional scales' generic assessments of generalized anxiety, establishing the first surgical

context-specific psychological assessment tool. The primary feature of the SPAC scale is its focus on specific dimensions of "worry" pertinent to surgical patients (such as fears about surgical risks, medical costs, and postoperative appearance), surpassing general anxiety screening questionnaires. By utilizing the results from the SPAC scale, healthcare providers can move beyond simplistic determinations of whether a patient is anxious, to a deeper understanding of what exactly concerns the patient. This understanding facilitates precise psychological interventions within the "reassuring" phase of the LEER model, such as targeted health education, risk communication, and commitment assurances, thus providing a direct basis for implementing a "identify-assess-intervene" closed-loop management. This approach holds promise for alleviating psychological burdens from the outset and improving perioperative outcomes[26].

Research Limitations and Future Prospects

The primary academic contribution of this study is the development and preliminary validation of a specific anxiety questionnaire designed for surgical contexts. Employing rigorous psychological measurement methods, we constructed and confirmed a three-dimensional factor structure that captures the core dimensions of preoperative worry. This effort provides both a conceptual model and a practical tool for perioperative psychological assessment, offering advantages over generic anxiety scales. This advancement not only deepens our understanding of anxiety experiences in this particular context but also establishes a theoretical foundation for future research into its antecedents, consequences, and intervention mechanisms.

Research Limitations

This study has the following limitations:

First, the representativeness of the sample is limited. The sample was derived exclusively from a single medical institution, which may compromise the generalizability of the findings. It is imperative that future research be conducted across multicenter hospitals at various levels and with larger sample sizes to further ascertain the universal applicability of this scale.

Second, the study exhibits methodological limitations. Although it assessed discriminant validity, it failed to evaluate concurrent validity or reactivity (i.e., the extent to which scale scores sensitively reflect changes before and after interventions), nor did it assess convergent validity. Furthermore, while the 3-point Likert scale simplifies patient responses, it may introduce ceiling or floor effects, potentially diminishing the scale's sensitivity to detect subtle changes in anxiety levels following interventions. Additionally, the absence of a universally

accepted gold standard for diagnosing ‘anxious condition’ somewhat limits the comprehensiveness of the validity evaluations.

Third, the testing of criterion-related validity is inadequate. From the perspective of rigorous psychometric standards, a significant limitation of this study is the lack of sufficient assessments of both convergent and discriminant validity against established psychometric instruments, such as the State-Trait Anxiety Inventory and the Hospital Anxiety and Depression Scale. This limitation somewhat undermines our confidence that the new scale accurately measures a distinct psychological construct that is separate from existing ones.

Future Research Directions

Given the aforementioned limitations, future research should proceed in the following directions:

(1) Multicenter, Cross-Cultural Studies: Primary efforts should focus on validating the robustness of the factor structure of the Surgical Patient Anxiety Status (SPAC) scale and exploring the ‘cultural specificity’ and ‘cross-contextual universality’ of anxiety themes.

(2) Enhanced Validity Testing: Rigorous criterion-related and discriminant validity studies are essential. These should involve correlating SPAC scale scores with established anxiety and depression scales, while also examining the scale’s predictive validity against postoperative recovery indicators such as pain scores, length of hospital stay, and complications.

(3) Expansion of Clinical Applications: Large-scale surveys should be conducted to assess the applicability of the SPAC scale among surgical inpatients, alongside in-depth analyses of factors influencing ‘anxious condition.’ Additionally, targeted psychological intervention programs should be developed based on scale assessment results and validated through randomized controlled trials.

Conclusion

In summary, the SPAC scale represents a scientifically robust, reliable, valid, and practical specialized assessment tool. Its development not only introduces a novel approach for the psychological assessment of surgical patients but also enhances the understanding of manifestations of ‘anxious condition’ in specific patient populations. This holds substantial value for advancing psychological practices within the Enhanced Recovery After Surgery framework.

Author Contributions Li Wei: data analysis, manuscript drafting, and research design; Yang

Jie, Lei Zehua, Zeng Guojun: academic leadership, overall project design, planning, coordination, guidance, manuscript revision, and writing guidance; Lijun Wang,Zhou Li: data organisation; Xu Fengjiao, Xiong Hui: data collection; Zhao Xin: writing contribution.

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

Declarations

Ethics approval and consent to participate This study has been approved by the Ethics Committee of Leshan People's Hospital (Approval No. [LYLL[2023]KY032]).

Consent to Participate

All individual participants included in the study signed informed consent forms.

Conflict of Interest All authors declare no conflicts of interest.

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