

Assessing Discomfort with IPREA-China in adult intensive care patients with severe acute pancreatitis

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Article

Keywords: severe acute pancreatitis, Discomfort, Influencing factors, IPREA-China

Posted Date: March 19th, 2025

DOI: <https://doi.org/10.21203/rs.3.rs-6211454/v1>

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Additional Declarations: No competing interests reported.

Abstract

Background: Severe acute pancreatitis (SAP) patients in intensive care units (ICU) frequently experience multidimensional discomfort, yet validated tools like the Chinese version of the Inconforts des Patients de REAnimation (IPREA-China) remain underutilized in this population. Guided by Kolcaba's comfort theory, this study aimed to fill the gap in understanding and managing discomfort in SAP patients.

Objective: To assess discomfort levels using the IPREA-China, identify predictors of severity, and propose effective intervention strategies.

Design: A single-center, cross-sectional study adhering to STROBE guidelines.

Setting(s): Conducted at the Pancreatitis Diagnostic and Treatment Center in Guizhou Province, China, equipped with 70 ICU beds and specialized multidisciplinary care.

Participants: Within 24 hours of transfer from the ICU, 245 conscious SAP patients completed the IPREA-China questionnaire between January 2021 and October 2023.

Methods: Data were collected via convenience sampling, encompassing demographic information, disease-related data (APACHE-II, BISAP, Barthel Index), and IPREA-China scores. The IPREA-China scale assessed 17 discomfort items across three dimensions: psychological/physical, environmental, and physiological needs. Ordered logistic regression analysis was used to identify predictors of discomfort severity among demographic and clinical disease characteristics.

Results: All 245 patients reported discomfort during ICU stays, with a median total score of 59 (IQR: 53–72). Discomfort severity was categorized as mild (15.1%), moderate (73.1%), or severe (11.8%), with moderate discomfort being predominant. Key findings include: Mental and Physical Discomforts: Moderate discomfort was predominant, driven by pain (59.2%), anxiety (51.4%), and restricted mobility (49.4%). Environment-related Discomforts: Mild discomfort prevailed, with noise (53.9%), sleep disturbances (55.5%), and bed-related discomfort (59.6%) as major contributors. Physiological Need-related Discomforts: Notably, thirst had the highest total score, with thirst emerging as the most severe symptom (57.6% mild, 17.1% severe), followed by hunger (14.7%). Multivariate analysis identified the following independent predictors of a higher degree of discomfort: male gender ($\beta=3.983$), recurrence ($\beta=1.619$), mechanical ventilation ($\beta=6.980$), diarrhea ($\beta=3.213$), low Barthel Index ($\beta=-0.185$), and high BISAP scores ($\beta=2.286$). Lack of appetite ($\beta=-3.763$) was associated with a lower degree of discomfort.

Conclusions: The IPREA-China effectively identifies the core discomfort sources in SAP patients. For high-risk groups, such as males, those with recurrence, mechanical ventilation, diarrhea, and high BISAP scores, an integrated 4D intervention strategy that encompasses physical, psychological, social, and environmental measures, along with STEP-CARE framework prioritizing sleep, thirst, environment, and pain management, should be adopted to alleviate discomfort and enhance the ICU treatment experience for SAP patients.

What is already known

- ICU patients often experience multidimensional discomfort, which negatively affects recovery and quality of life.
- The discomfort of SAP patients is understudied and lacks assessment using the IPREA-China.

What this paper adds

- This study provides the first assessment of discomfort in SAP patients using the IPREA-China, filling the gap.
- We identified gender, recurrence, diarrhea, mechanical ventilation, low Barthel Index, and high BISAP score as predictors of discomfort.
- We propose a 4D strategy and the STEP-CARE measure to improve discomfort management in the ICU.

1. Introduction

Severe acute pancreatitis (SAP) is an inflammatory disease characterized by persistent organ failure with a duration of > 48h, which accounts for 20%-30% of acute pancreatitis (AP), and the case fatality rate is 30%-50% higher than that of AP.¹⁻³ With the development of society and the improvement of the economic level of the population, the incidence of SAP has been increasing year by year.^{4,5} Due to the viciousness of the disease, long treatment period and high recurrence rate, SAP patients experience different degrees of physical, somatic, environmental and psychological discomfort, which may cause emotional depression, pain, fear, anxiety, depression and other stress reactions.^{5,6} At the same time, these negative emotions can lead to excessive tension in the cerebral cortex, endocrine, autonomic, and neurological dysfunction, which can seriously reduce patients' treatment compliance and body immunity, and affect the recovery and prognosis of the organism.^{7,8}

In recent years, with the shift in medical model, healthcare professionals have been paying more attention to the subjective experience and psychological needs of patients. Kolcaba's comfort theory emphasizes that comfort is a multidimensional state that includes four dimensions: physical, psychological, social, and environmental, and that discomfort in these dimensions can directly affect patients' recovery and quality of life.⁹ Patient discomfort is particularly prominent in the ICU environment, and special circumstances such as high noise levels, bright light, frequent medical manipulation, and restricted visitation in the ICU can be sources of discomfort.¹⁰

Although there have been studies focusing on the discomfort experience of ICU patients, relatively few studies have been conducted on SAP patients.^{11,12} Moreover, no studies have been conducted that apply the Chinese version of the Inconforts des Patients de REAnimation (IPREA-China) to patients with Severe Acute Pancreatitis (SAP). This leaves us with a poor understanding of the discomfort experience of SAP patients in the ICU. Therefore, this study attempts to investigate the discomfort of SAP patients

during ICU using IPREA-China, to explore the risk factors for patients' discomfort experience, and to provide a reference for the development of scientific and rational management strategies.

The innovation of this study is that IPREA-China was applied to SAP patients for the first time, filling the gap in this field. Meanwhile, this study not only assessed the level of discomfort in SAP patients, but also systematically analyzed the effects of demographic and clinical characteristics on different levels of discomfort, which provided a scientific basis for the development of personalized nursing interventions. Through this study, we expect to provide practical guidance to clinical healthcare professionals to help them better recognize and manage the discomfort symptoms of SAP patients, thereby improving their discomfort and quality of life.

2. Methods

2.1 Study design

This study employed a single-center, cross-sectional, descriptive, single-cohort design. The study was approved by the Biomedical Research Ethics Committee of the Affiliated Hospital of Zunyi Medical University prior to patient recruitment (KLL2022645). The report adheres to the STROBE guidelines for observational studies in epidemiology.

2.2 Theory Evidence:

The ICU is a closed environment, and patients in the ICU may experience a multitude of discomforts. Kolcaba's comfort theory provides systematic theoretical support for this study through its multidimensional framework (physical, psychological, social, and environmental) and its hierarchical categorization of "Pain-free-Comfort-Transcendence."^{13,14} This systematic theoretical support guided the research team to comprehensively identify the sources of discomfort in SAP patients across four dimensions. Such as pain and respiratory distress in the physical dimension; anxiety and depression in the psychological dimension, social isolation and no cell phone access in the social dimension, and noise or bed discomfort in the environmental dimension.

Both internal and external stimuli (e.g., internal anxiety versus external ICU environmental disturbances) were incorporated into the theoretical framework.¹² Based on this theory, patient discomfort was assessed using the IPREA-China to provide data support and analyze the influence of demographic and clinical characteristics on discomfort levels, thereby developing targeted interventions. Additionally, the theory highlights the "transcendent" level of discomfort, guiding future research to not only alleviate basic discomfort but also explore innovative strategies to enhance patients' physical and mental satisfaction.

Within the framework of Kolcaba's comfort theory, Fig. 1 visualizes the discomfort induced by external and internal stimuli in SAP patients, showing the dynamic relationship between stimulus sources and

comfort states. This provides a theory-driven practical pathway to improve SAP patients' comfort and quality of life.

2.3 Study environment and population

This study was conducted at the Pancreatitis Diagnostic and Treatment Center in Guizhou Province, China, which brings together multidisciplinary resources including clinical, anesthesia, nursing, traditional Chinese medicine, imaging, ultrasound, nutrition and rehabilitation. Equipped with two ICUs totaling 70 beds and 230 healthcare professionals, it has established a comprehensive pancreatitis database and is dedicated to the comprehensive treatment of pancreatitis patients. This study was limited to SAP patients who were conscious at the time of discharge from the ICU.

2.4 Recruitment, screening, and enrollment

The study team posted recruitment information via the Internet at the treatment center. After SAP patients were transferred to the ICU, designated staff provided detailed information to the patients or their legal representatives. After obtaining initial consent, the study team assessed patient eligibility based on inclusion and exclusion criteria such as age, diagnosis, medical history, and laboratory results, and recorded reasons for exclusion. For eligible patients, a team member described in detail the study's purpose, methodology, potential risks, and benefits, and obtained an informed consent form after ensuring the patient's full understanding. Eligible patients completed the IPREA-China scale within 24 hours of being transferred from the ICU. After registration, each participant was given a unique identification number to ensure data confidentiality and accuracy.

2.4 Inclusion, exclusion, and dropout criteria

2.4.1 Inclusion criteria

- (1) Patients diagnosed with SAP according to the 2019 Chinese Guidelines for the Diagnosis and Treatment of Acute Pancreatitis;
- (2) Age ≥ 18 years old;
- (3) Being conscious and able to speak clearly and answer questions accurately at the time of discharge from the ICU;
- (4) No history of psychological illness
- (5) Voluntary participation in this study.

2.4.2 Exclusion criteria

- (1) Pancreatitis during pregnancy;
- (2) cultural or other constraints that prevent them from answering relevant questions or filling in information

(3) Participation in other interventional studies affecting this study;

(4) Patients with communication difficulties due to tracheotomy.

2.4.3 Withdrawal Criteria

(1) Incomplete information.

(2) Withdrawal of consent by the patient, i.e., the patient or his/her legal representative decides not to participate for personal reasons.

2.5 Sample size

The sample size was determined based on the number of items and the expected attrition rate. In this study, the IPREA-China questionnaire was used, which contains 17 items. The sample size was set at 10 to 15 times the number of items, i.e., 170 to 255 participants. Considering a 15% attrition rate, 195 to 294 participants were needed.

2.6 Dependent variables and the IPREA-Chian data collection

2.6.1 General Information: A "General Information Questionnaire" was designed in accordance with clinical practice. It included: (1) demographic data: gender, age, marital status, per capita monthly family income, etc.; (2) disease-related data: whether it was the first onset of SAP, etiology, APACHE II score (within 24 hours of ICU admission). During the ICU stay, the modes of respiratory support (MV: mechanical ventilation, HFNC: high-flow nasal cannula, nasal oxygen therapy), whether continuous renal replacement therapy (CRRT) was performed, occurrence of delirium, lack of appetite, breathing difficulties (respiratory rate > 26 breaths/min), nausea and vomiting, constipation, and diarrhea, etc., were recorded. The highest intra-abdominal pressure(IAP) during the ICU stay was also noted.

2.6.2 Barthel Index: This scale was used to evaluate ICU patients' daily living activities across four levels with ten items: eating, bathing, dressing, bowel and bladder control, toileting, transferring, walking on flat ground, and stairs. Scores range from 0 to 100, with higher scores indicating greater independence. Scores of 0–20 indicate complete dependence, 21–60 indicate severe dependence, 61–90 indicate moderate dependence, 91–99 indicate mild dependence, and a score of 100 indicates complete self-sufficiency.¹⁵ Data was collected daily in the ICU, using the lowest score as the indicator.

2.6.3 BISAP: Bedside index of severity of acute pancreatitis was used to assess the severity of acute pancreatitis with the following criteria: B: urea nitrogen > 25 mg/dl; I: Glasgow Coma Score < 15; S: systemic inflammatory response syndrome; A: age ≥ 60 years; P: pleural effusion. One point was recorded for each criterion met within 24 hours, with a total score ranging from 0 to 5.^{16,17} A BISAP score of ≥ 3 can predict the severity of Severe Acute Pancreatitis (SAP) with a sensitivity of 83%. The higher the score, the more severe the condition. Collection time: within 24 hours of admission to ICU.

2.6.4 IPREA-China: The original IPREA scale was developed by French scholar Kalfon, and the French version of the IPREA scale has 18 entries organized into 3 dimensions to assess discomfort in ICU

patients.^{18,19} The English version has been reported to be used several times.^{11,12,20} In 2015, Yanhong Xie and colleagues translated the IPREA scale into Chinese, keeping 17 items.²¹ They merged "Feeling depressed without a phone" and "Feeling depressed in the ICU" into one item under mental and physical discomforts. The IPREA-China includes mental and physical discomforts (loneliness, pain, anxiety, restricted mobility due to catheters and body restraints, breathing difficulties, depression, limited visiting hours, lack of privacy, lack of informed condition), environment-related discomforts (sleep disorders, noise disturbances, light irritation, bed-related discomfort, feeling of hot), and physiological need-related discomforts (thirst, hunger, feeling of cold). The scale uses a 0 to 10 visual analog scale for scoring, with 0 indicating comfort and 10 indicating extreme discomfort. Discomfort levels are categorized into mild (1–3), moderate (4–6), and severe (7–10). Total scores correspond to these levels as follows: mild discomfort (1–51), moderate discomfort (52–102), and severe discomfort (103–170). The scale demonstrates good reliability and validity, with correlation coefficients ranging from 0.562 to 0.899, a content validity of 0.92, and a Cronbach's α coefficient of 0.834. It is concise and easy to understand, suitable for conscious ICU patients without communication barriers, aiding healthcare staff in dynamically monitoring patients' discomfort levels. Data collection was conducted within 24 hours after transfer out of the ICU to capture the overall discomfort experienced during the ICU stay.

2.7 Quality control

To ensure data quality, this study implemented rigorous training and standardized procedures for data collection. Five researchers were trained and certified before starting the study. Clinical data were collected from medical records and databases, and the IPREA-China questionnaire was completed both online and offline. The questionnaire included basic information, marital status, and per capita monthly household income.

Young and tech-savvy patients were encouraged to complete the questionnaire independently by scanning a QR code via the WeChat app, which required full completion before submission to enhance data integrity. For elderly or illiterate patients, trained staff assisted in filling out the questionnaire, reading out items and recording responses. The process was conducted in a quiet, well-lit environment with muted equipment to minimize distractions. Hearing aids and glasses were provided as needed. All interactions adhered to a standardized script to ensure consistency in data collection.

Upon retrieval, questionnaires were immediately checked for completeness, and any missing or unclear responses were addressed promptly. The research team regularly monitored the data collection process, followed up with participants, and recorded any withdrawals. Data were independently entered by two individuals, and discrepancies were resolved through discussion to ensure accuracy.

2.8 Data analysis

Data were analyzed using SPSS 29.0 software (IBM Corp., Armonk, NY, USA, Version 29.0). Numbers, percentages, means and standard deviations (SD), and medians and interquartile ranges (IQR) were used to describe sample characteristics. One-way ANOVA or nonparametric tests were used for between-

group comparisons of continuous measures; chi-square tests or Fisher's exact test were used for categorical variables; ordinal multicategorical logistic regression analyses were used to identify independent influences on the discomfort experience in patients with SAP, with all tests being two-sided and $P < 0.05$ being considered statistically significant. Violin plots were created using GraphPad Prism V10.0 to illustrate the distribution of different datasets.

3 Results

3.1 Recruitment and characteristics

A total of 328 patients were screened for this study, with 245 completing all measurements. Participants included 57.1% males and 42.9% females, with a median age of 42 years. The majority were married (85.7%), with 32.2% earning less than ¥2,000 per capita monthly and 30.6% earning more than ¥4,000. Disease characteristics showed that 14.7% had a history of recurrence, 45.7% had biliary pancreatitis, and 48.6% had hyperlipidemic pancreatitis. Regarding respiratory support, 25.7% received MV and 37.1% used HFNC. The median IAP was 11 mmHg, and the median APACHE-II score was 14. Of these patients, 28.6% underwent CRRT, and 8.6% experienced delirium. In terms of symptoms, 80.8% experienced nausea and vomiting, 89.8% had constipation, 90.2% had diarrhea, and 91.4% lacked appetite. The median Barthel Index and BISAP scores were 10 and 2, respectively. The diversity of the patient population provides a solid data base for evaluating the discomfort experience in patients with SAP. Demographic and disease characteristics data are detailed in **Table 1**.

3.2 Current status of SAP patient discomfort experience (IPREA-China) score

All 245 SAP patients experienced discomfort during their stay in the ICU according to the IPREA-China scale, with an incidence of 100%. The overall median score was 59 (53-72), with a maximum of 129 and a minimum of 43. Of these patients, 15.1% (37/245) had mild discomfort with a median score of 50 (48-50), 73.1% (179/245) had moderate discomfort with a median score of 60 (56-68), and 11.8% (29/245) had severe discomfort with a median score of 107 (105-117). Specific data are shown in **Figure 2**.

The data indicated that among SAP patients, moderate discomfort was most prevalent in the mental and physical discomfort dimension. In the environment-related and physiological need-related discomfort dimensions, mild discomfort was more common than moderate discomfort. Overall, severe discomfort had the lowest percentage among SAP patients. In the mental and physical discomfort dimension, moderate discomfort was most frequently characterized by pain (59.2%), breathing difficulties (57.1%), depression (55.1%), and limited visiting hours (54.7%). In the environment-related discomfort dimension, common mild discomfort symptoms included feeling hot (62.4%), bed-related discomfort (59.6%), and sleep disorders (33.5%). In the physiological need-related discomfort dimension, common mild discomfort symptoms were thirst (57.6%), hunger (54.3%), and feeling cold (64.1%). Further analysis showed that in the severe discomfort group, thirst was the most prevalent at 17.1%, followed by hunger at 14.7%, significantly higher than other symptoms and thus requiring particular attention. Other notable

data included anxiety (51.4%), noise disturbances (53.9%), and light irritation (49.4%), with detailed data presented in **Table 2**.

In addition, the distribution of individual discomfort items for each dimension among SAP patients was visualized using violin plots. The width of the violin plot indicates the density of the data, with wider sections representing a higher number of patients experiencing the same level of discomfort. By visually comparing the dimensions, it is possible to identify the areas of discomfort that are most intense for patients. The total scores for each dimension were ranked as follows: D3-1 > D1-7 > D1-8 > D2-1 > D1-2 > D1-4 > D2-2 > D1-3 > D1-6 = D2-3 > D3-2 > D1-5 > D2-4 = D2-5 > D3-3, with the highest total score being 1051 for thirst, and the lowest score being 894 for feeling cold, as depicted in **Figure 3**.

3.3 Univariate Analysis of Discomfort Degree

As shown in **Table 1**, in addition to APACHE II scores, etiology, and breathing difficulties, several other variables were significantly associated with the degree of discomfort ($P < 0.05$). The differences in the distribution of discomfort degree among groups suggest that these factors may significantly impact patients' discomfort experiences. Specifically, married patients exhibited a lower degree of discomfort, and a higher per capita monthly household income was associated with a lower degree of discomfort. Patients with a history of recurrence experienced a higher degree of discomfort. Additionally, patients receiving MV and HFNC had higher degrees of discomfort. Those with higher IAP, undergoing CRRT, and experiencing delirium, nausea and vomiting, constipation, and diarrhea were also associated with more severe discomfort degrees. Furthermore, lower Barthel Index scores and higher BISAP scores were both associated with a more severe discomfort experience.

3.4 Ordered Multicategorical Logistic Regression Analysis of Discomfort Degree

In the univariate analysis, variables with statistically significant associations were selected as independent variables, with the degree of discomfort serving as the dependent variable, using ordered multi-categorical logistic regression analysis. The covariance analysis results indicated that each model had a tolerance value less than 1 and a variance inflation factor less than 10, suggesting no multicollinearity among the independent variables and their suitability for inclusion in the regression model. The parallel line test of the models showed that the proportional odds assumption was met, confirming the applicability of ordered multi-categorical logistic regression analysis. Several key independent factors influencing the discomfort experience of SAP patients were identified: male patients ($\beta = 3.983$) and those with a history of relapse ($\beta = 1.619$) were more likely to experience more severe discomfort; patients receiving MV ($\beta = 6.980$) and HFNC ($\beta = 4.650$) had a higher degree of discomfort; patients with diarrhea ($\beta = 3.213$) had significantly higher degree of discomfort; whereas lack of appetite ($\beta = -3.763$) was associated with a lower degree of discomfort; and both lower Barthel Index ($\beta = -0.185$) and higher BISAP scores ($\beta = 2.286$) were associated with a more severe experience of discomfort. These findings provide a basis for targeted clinical interventions. The results are shown in **Table 3**.

4 Discussion

4.1 Prevalence of Discomfort in SAP Patients

In this study, we found that all 245 SAP patients experienced discomfort symptoms, with an incidence rate of 100%, indicating that SAP patients commonly experience discomfort across psychological, physical, environmental, and physiological needs during hospitalization. In the complex ICU environment, SAP patients are subjected to multiple pressures such as disease severity, treatment duration, nursing procedures, financial stress, family burden, and future uncertainty, which aggravate the physical and psychological burdens.^{12,18,22,23} The more severe the condition, the longer the treatment cycle, and the higher the costs associated with SAP, the more intense the negative emotions and the higher the risk of triggering psychiatric disorders.²⁴ This study showed that 15% of SAP patients had mild discomfort, 73% had moderate discomfort, and 12% had severe discomfort, with moderate and mild discomfort being more prevalent and severe discomfort being less common.

The discomfort of SAP patients in this study was mainly reflected in the following aspects: (i) Mental and physical-related discomforts: Moderate discomfort was about 37.1%-59.2%, mild discomfort was about 34.4%-54.3%, and severe discomfort was about 2.9%-11.4%. These discomforts were mainly manifested in loneliness, pain, anxiety, limited activity, dyspnea, depression, restriction of visitation, and respect for privacy. Currently, the eCASH concept has largely alleviated abdominal pain, abdominal distension, nausea, vomiting, and other discomforts in SAP patients during ICU treatment, reducing the discomfort degree of patients.^{25,26} SAP patients are eager to receive active encouragement and support from healthcare personnel, family, and society, and such support can effectively alleviate the patients' loneliness and fear, and increase their confidence in overcoming the disease.²² (ii) Environment-related discomforts: The majority of SAP patients (49.4%-62.4%) experienced mild discomfort in sleep, noise, light, beds, etc., and a small number had severe discomfort (4.1%-11.4%). The ICU's therapeutic environment, such as abnormal light levels and high-frequency noise from ventilator alarms and other equipment, can disturb sleep-wake rhythms, potentially causing discomfort. This may be a significant cause of discomfort in ICU patients.²⁷ Despite significant improvements in the ICU environment due to socioeconomic progress and modernization, continuous optimization remains an important issue.²⁸ (iii) Physiological need-related discomforts : Mild discomfort accounted for the largest proportion, about 54.3%-64.1%, indicating that thirst, hunger, and cold were the most common. Thirst had the highest total score and the highest proportion of severe discomfort, indicating it is the most prominent problem in SAP, possibly related to the disease's requirement for abstaining from drinking and fasting.^{22,23} Regular and reasonable assessment of patients' physiological conditions and early nutritional support and fluid resuscitation strategies are necessary to meet patients' physiological needs.^{4,5}

Additionally, SAP patients' long-term prognosis and quality of life outcomes are related to their experiences during ICU hospitalization, and assessing discomfort experiences and sources can facilitate early identification of high-risk groups and timely adoption of targeted treatment and care strategies, which is crucial for improving long-term prognosis.

4.2 Influences on SAP Patients' Discomfort

Univariate analysis indicated that younger patients, unmarried status, lower income levels, high IAP, CRRT, delirium, and constipation were significantly associated with increased discomfort in SAP patients. Younger patients may experience greater discomfort due to the uncertainty of disease prognosis and heightened psychological stress sensitivity.²⁰ Loneliness and anxiety are more pronounced in unmarried patients due to the lack of emotional support, consistent with findings from a study by Yanhong Xie et al.²¹ Lower-income patients face economic constraints that limit treatment adherence and access to care resources, thereby exacerbating discomfort. High IAP and constipation intensify the physiological burden by causing abdominal pain, bloating, and abdominal compartment syndrome.²⁹ While CRRT can exacerbate discomfort due to hemodynamic fluctuations and catheter tethering.³⁰ Delirium, in synergy with ICU environmental stimuli such as constant light and noise, can lead to cognitive disorganization and reduced tolerance to medical procedures.³¹ The lack of statistical significance of Etiology, APACHE-II scores, and Breathing difficulties on the degree of discomfort could be attributed to several factors. The APACHE-II scores were measured within 24 hours of ICU admission, which may not adequately reflect the severity of patients' conditions throughout their hospital stay. Additionally, since Breathing difficulties occur in 94.3% of SAP patients, it is a common symptom with little variability, potentially leading to a lack of discriminative power in statistical analysis. Furthermore, insufficient sample size or measurement errors in variables might also impact the statistical significance of the findings.

Logistic regression analysis identified male gender, history of relapse, MV, HFNC, diarrhea, elevated BISAP score, and low Barthel Index as significant independent predictors of discomfort in SAP patients. The possible reasons for higher discomfort in males may include inadequate pain expression leading to insufficient analgesia, enhanced inflammatory responses mediated by androgens, and lower tolerance to invasive procedures.²² Relapsing patients often experience "treatment fatigue" and progressive impairment of pancreatic function, which compounds the psychological and physical burdens they endure.²³ MV and HFNC directly induce discomfort through laryngeal irritation and respiratory machine asynchrony.³² Diarrhea leads to hypokalemia, acidosis, and perianal skin damage, exacerbating discomfort through multiple mechanisms. A high BISAP score reflects active systemic inflammatory response syndrome (SIRS), directly worsening fever, tachycardia, and other physiological stressors.^{16,17} A low Barthel Index indicates limited daily activity ability, increasing the risk of pressure ulcers and feelings of helplessness. Notably, "lack of appetite" ($\beta = -3.763$) was associated with lower discomfort, which may be counterintuitive but could relate to early enteral nutritional intervention reducing gastrointestinal discomfort, and disease or treatment process causing decreased appetite, thereby reducing overall discomfort.

4.3 The 4D Intervention Strategy Based on Kolcaba's Comfort Theory

This strategy covers four dimensions: physical, psychological, social, and environmental. On the physical dimension, a stepwise analgesia plan, including epidural block and intravenous Patient-Controlled

Analgesia (PCA), alleviates pain, while dynamic fluid replacement ensures hydration and electrolyte balance, and nutritional support.³³⁻³⁶ Psychological interventions include family-involved care to ensure more family presence, cognitive-behavioral therapy, writing, and or for communication, aimed at reducing anxiety and depression. Social measures focus on providing financial aid and early mobile phone access, establishing post-ICU clinics to alleviate economic stress and strengthen social ties.³⁷⁻⁴¹ Environmental improvements focus on optimizing ICU layout and using more comfortable beds to minimize environmental disturbances.^{27,42} Additionally, STEP-CARE interventions further refine management of Sleep, Thirst, Environment and Pain, including light cycle regulation to simulate natural rhythms for better sleep, stepwise fluid replacement and cold oral sprays for thirst relief, noise-cancelling earplugs and concentrated night-time care to reduce environmental interference, and multimodal analgesia combining epidural block and music therapy to further alleviate pain.^{43,44} Integrating Kolcaba's comfort theory, future research can explore an integrated physical-psychological-social-environmental intervention strategy to transition patients from a "pain-free" state to "transcendent comfort," significantly enhancing their overall ICU experience.

5. Conclusion

Based on Kolcaba's comfort theory, this study found that most SAP patients experienced moderate discomfort during hospitalization, with male gender, history of recurrence, MV, HFNC, diarrhea, BISAP, and Barthel Index as key influencing factors. These findings offer an important reference for assessing discomfort in SAP patients and provide a scientific basis for clinical care. Accordingly, this study proposed a comprehensive 4D intervention strategy, including stepwise analgesia, family involvement, financial aid, social support, environmental enhancement, and STEP-CARE measures to further refine the management of Sleep, Thirst, Environment, and Pain. Based on this framework, future studies could explore more effective integrated intervention models to promote the transition from "pain-free" to "transcendent comfort," significantly enhancing patients' overall experience and quality of life in the ICU.

6. Limitations

This single-center study with a limited sample size relied on subjective patient feedback for data collection. Some variables were gathered within 24 hours post-transfer to the ICU without accounting for additional factors. The generalizability of the findings may be limited. Future research still requires further validation through multicenter studies with larger samples, more variables, and more objective discomfort indicators.

7. Practical Significance

This study identified the key factors affecting the discomfort of SAP patients and proposed 4D intervention strategies and STEP-CARE measures based on Kolcaba's comfort theory. These findings

provide a scientific basis for clinical care, helping to improve patient experience, enhance the quality of ICU care, and promote personalized nursing practice.

Declarations

Acknowledgements

We extend our heartfelt thanks to our patients, the healthcare team, and the Pancreatitis Diagnostic and Treatment Center. Without their invaluable contributions, this work would not have been possible.

Authors' contributions

Conception and design of the research: You Yuan, Qian Luo, Bao Fu

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All authors read and approved the final draft.

Funding

This study was supported by grants from the Universities Young Science and Technology Talent Growth Project in Guizhou Province (Qian Jiao He KY Zi [2021] 213), the Guizhou Province Science and Technology Plan Project (No.gzwmkj2022-251), (No.gzwmkj2024-560) and (No.gzwmkj2024-554), the Zunyi Science and Technology Plan Project in Guizhou Province (ZunShi KeHe No. HZ[2023] 318), and (ZunShi KeHe No. HZ[2024] 267).

Ethics statement

Ethics and dissemination Ethics approval was obtained from Biomedical Research Ethics Committee of the Affiliated Hospital of Zunyi Medical University (KLL2022645).

Data Availability Statement

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

Disclaimer

The funding source has no role in the design of the study and will not have any role during the execution, analyses, interpretation of the data, or decision to submit results.

Disclosure statements

The authors report no conflict of interest

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Tables

Table 1: Univariate Analysis of Demographics, Disease Characteristics, and Discomfort in SAP Patients

Demographic and Disease characteristics	M(P25,P75) n(%) (N=249)	Mild discomfort (n=37)	Moderate discomfort (n=179)	Severe discomfort (n=29)	Statistical value	P value
Age (years)	42(32,52)	49(34,59)	43(32,52)	34(29,40)	12.888 ^a	0.002
Gender					25.955 ^b	<0.001
Male	140(57.1)	13(35.1)	99(55.3)	28(96.6)		
Female	105(42.9)	24(64.9)	80(44.7)	1(3.4)		
Marriage					42.936 ^b	<0.001
Unmarried	21(8.6)	0(0.0)	7(3.9)	14(48.3)		
Married	210(85.7)	37(100.0)	158(88.3)	15(51.7)		
Divorced	7(2.9)	0(0.0)	7(3.9)	0(0.0)		
Other	7(2.9)	0(0.0)	7(3.9)	0(0.0)		
Per capita monthly household income (¥:Yuan)					10.749 ^b	0.030
≤2000	79(32.2)	5(13.5)	61(34.1)	13(44.8)		
2000~3999	91(37.1)	17(45.9)	62(34.6)	12(41.4)		
≥4000	75(30.6)	15(40.5)	56(31.3)	4(13.8)		
Relapse or not					9.059 ^b	0.009
Yes	36(14.7)	3(8.1)	23(12.8)	10(34.5)		
No	209(85.3)	34(91.9)	156(87.2)	19(65.5)		
Etiology					9.885 ^b	0.083
Biliary SAP	112(45.7)	25(67.6)	72(40.2)	15(51.7)		
High-fat type	119(48.6)	12(32.4)	93(52.0)	14(48.3)		
Idiopathic	7(2.9)	0(0)	7(3.9)	0(0)		
Other	7(2.9)	0(0)	7(3.9)	0(0)		
Respiratory Support					52.501 ^b	<0.001
Mechanical Ventilation	63(25.7)	6(16.2)	49(27.3)	8(27.6)		
High flow nasal cannula	119(48.6)	5(13.5)	93(52.0)	21(72.4)		

Nasal Oxygen	63(25.7)	26(70.3)	37(20.7)	0(0)		
Intra-abdominal pressure(mm-Hg)	11(8,14)	12(10,16.5)	10(7,13)	15(11,20.5)	39.747 ^a	<0.001
APACHE-II	14(13,20)	14(12,17.5)	16(13,20)	16(13,19)	3.735 ^a	0.155
CRRT					8.321 ^b	0.016
Yes	70(28.6)	6(16.2)	50(27.9)	14(48.3)		
No	175(71.4)	31(83.8)	129(72.1)	15(51.7)		
Delirium					8.612 ^b	0.008
Yes	21(8.6)	0(0.0)	21(11.7)	0(0.0)		
No	224(91.4)	37(100.0)	158(88.3)	29(100.0)		
Nausea and vomiting					26.438 ^b	<0.001
Yes	196(80.8)	24(64.9)	157(87.7)	15(51.7)		
No	49(20.0)	13(35.1)	22(12.3)	14(48.3)		
Constipation					25.351 ^b	<0.001
Yes	220(89.8)	24(64.9)	171(95.5)	25(86.2)		
No	25(10.2)	13(35.1)	8(4.5)	4(13.8)		
Diarrhea					7.817 ^b	0.013
Yes	221(90.2)	29(78.4)	167(93.3)	25(86.2)		
No	24(9.8)	8(21.6)	12(6.7)	4(13.8)		
Breathing difficulties					4.577 ^b	0.075
Yes	231(94.3)	37(100.0)	165(92.9)	29(100.0)		
No	14(5.7)	0(0.0)	14(7.8)	0(0.0)		
Lack of appetite					23.241 ^b	<0.001
Yes	224(91.4)	25(67.6)	170(95.0)	29(100.0)		
No	21(8.6)	12(32.4)	9(5.0)	0(0.0)		
Barthel Score	10(10,20)	25(25,30)	10(5,15)	10(5,10)	77.882 ^a	<0.001
BISAP score	2(1,3)	1(1,2)	2(1,3)	3(3,3.5)	68.129 ^a	<0.001

*a: Z-score, b: Chi-square value

Table 2: Distribution of Discomfort Degree among SAP Patients (n,%)

Items	Mild	Moderate	Severe
Mental and physical discomforts			
Loneliness	96(39.2)	124(50.6)	25(10.2)
Pain	84(34.3)	145(59.2)	16(6.5)
Anxiety	103(42.0)	126(51.4)	16(6.5)
Restricted mobility(Catheters & Body Restraints)	109(44.5)	121(49.4)	15(6.1)
Breathing difficulties	98(40.0)	140(57.1)	7(2.9)
Depression	100(40.8)	135(55.1)	10(4.1)
Limited visiting hours	88(35.9)	134(54.7)	23(9.4)
Lack of privacy	95(38.8)	122(49.8)	28(11.4)
Lack of informed of condition	133(54.3)	91(37.1)	21(8.6)
Environment-related discomforts			
Sleep disorders	136(55.5)	82(33.5)	27(11.0)
Noise disturbances	132(53.9)	85(34.7)	28(11.4)
Light irritation	121(49.4)	106(43.3)	18(7.3)
Bed-related discomfort	146(59.6)	89(36.3)	10(4.1)
Feeling of hot	153(62.4)	76(31.0)	16(6.5)
Physiological need-related discomforts			
Thirst	141(57.6)	62(25.3)	42(17.1)
Hunger	133(54.3)	76(31.0)	36(14.7)
Feeling of cold	157(64.1)	79(32.2)	9(3.7)

Table 3: Multicategorical Logistic Regression Analysis of the Degree of Discomfort in SAP

Subgroups of Dependent and Independent Variables and their Assignments					
Dependent variable (subgroup): 1=mild discomfort, 2=moderate discomfort, 3=severe discomfort					
Independent variables (demographic and disease-related characteristics p<0.05)					
Variable	Assignments				
Categorical Variables					
Gender	0=Male, 1=Female				
Marriage	0=Unmarried, 2=Married, 3=Divorced, 4=Widowed or other				
Income (¥:Yuan)*	0=≤2000, 1=2000–3999, 2=≥4000				
Respiratory Support	0=Mechanical Ventilation (MV), 1=High flow nasal cannula (HFNC), 2=Nasal Oxygen				
Relapse or not	0=NO, 1=YES				
CRRT*	0=NO, 1=YES				
Delirium	0=NO, 1=YES				
Nausea and vomiting	0=NO, 1=YES				
Constipation	0=NO, 1=YES				
Diarrhea	0=NO, 1=YES				
Lack of appetite	0=NO, 1=YES				
Continuous Variables					
Age (years)	Original value input				
IAP(mm-Hg)*	Original value input				
Barthel Score	Original value input				
BISAP score*	Original value input				
Logistic regression analysis of SAP patients' discomfort experience					
Items	β-value	Standard Error	Wald value	P-value	95%CI
Gender = Male	3.983	1.082	13.546	<0.001	1.862–6.104
Relapse = YES	1.619	0.763	4.502	0.034	0.124–3.115
Respiratory Support = MV	6.980	1.565	19.887	<0.001	3.913–10.048
Respiratory Support =HFNC	4.650	1.132	16.871	<0.001	2.431–6.869

Diarrhea = YES	3.213	1.098	8.563	0.003	1.061-5.365
Lack of appetite = YES	-3.763	1.234	9.298	0.002	-6.182-1.344
Barthel Score	-.185	0.045	16.813	0.001	-.274-0.097
BISAP score	2.286	0.434	27.785	0.001	1.436-3.136

***Income**:Per capita monthly household income, **IAP**:Intra-abdominal pressure, **CRRT**:Continuous Renal Replacement Therapy, **BISAP score**:Bedside Index for Severity in Acute Pancreatitis.

Figures

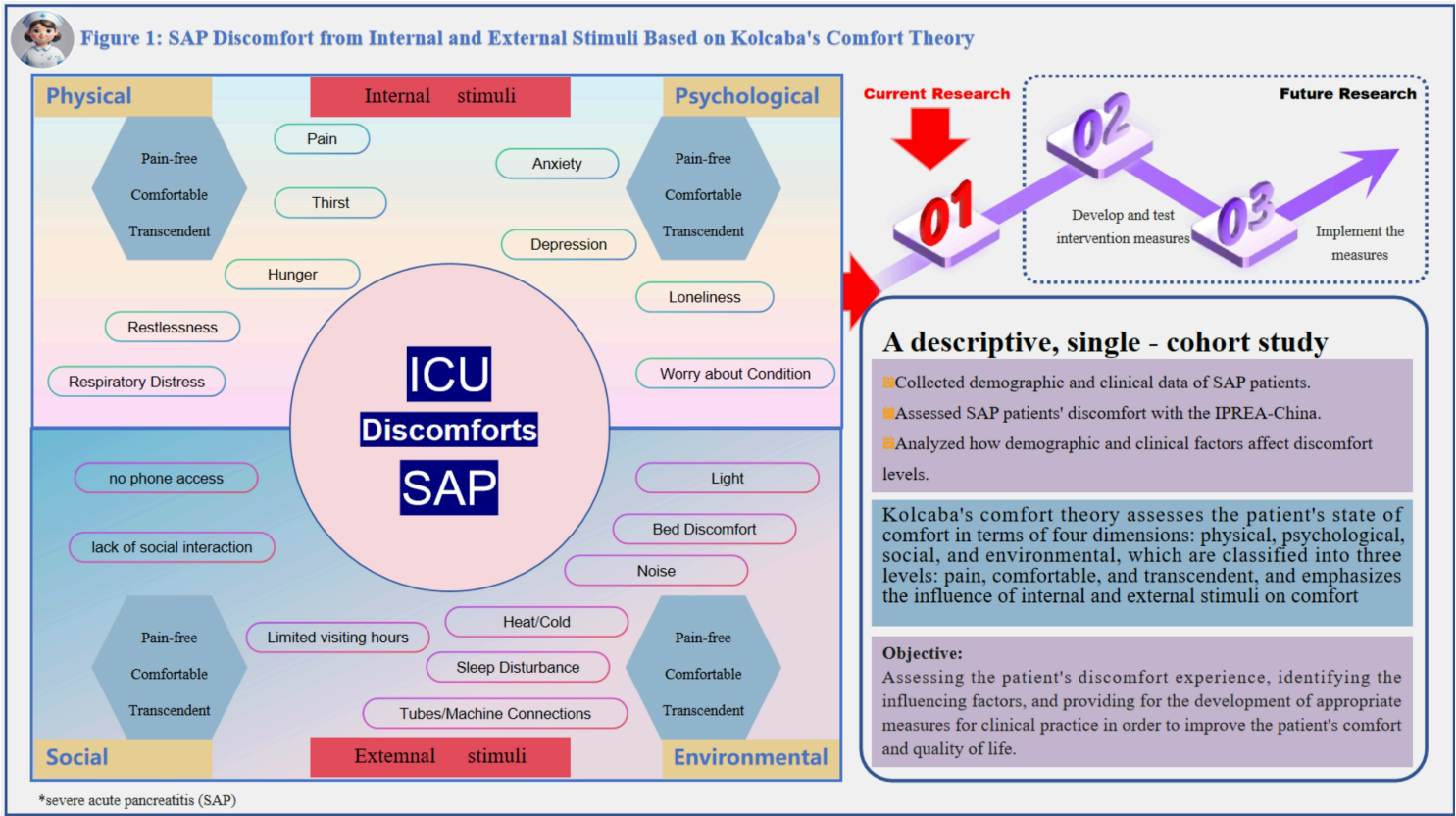


Figure 1

SAP Discomfort from Internal and External Stimuli Based on Kolcaba's Comfort Theory

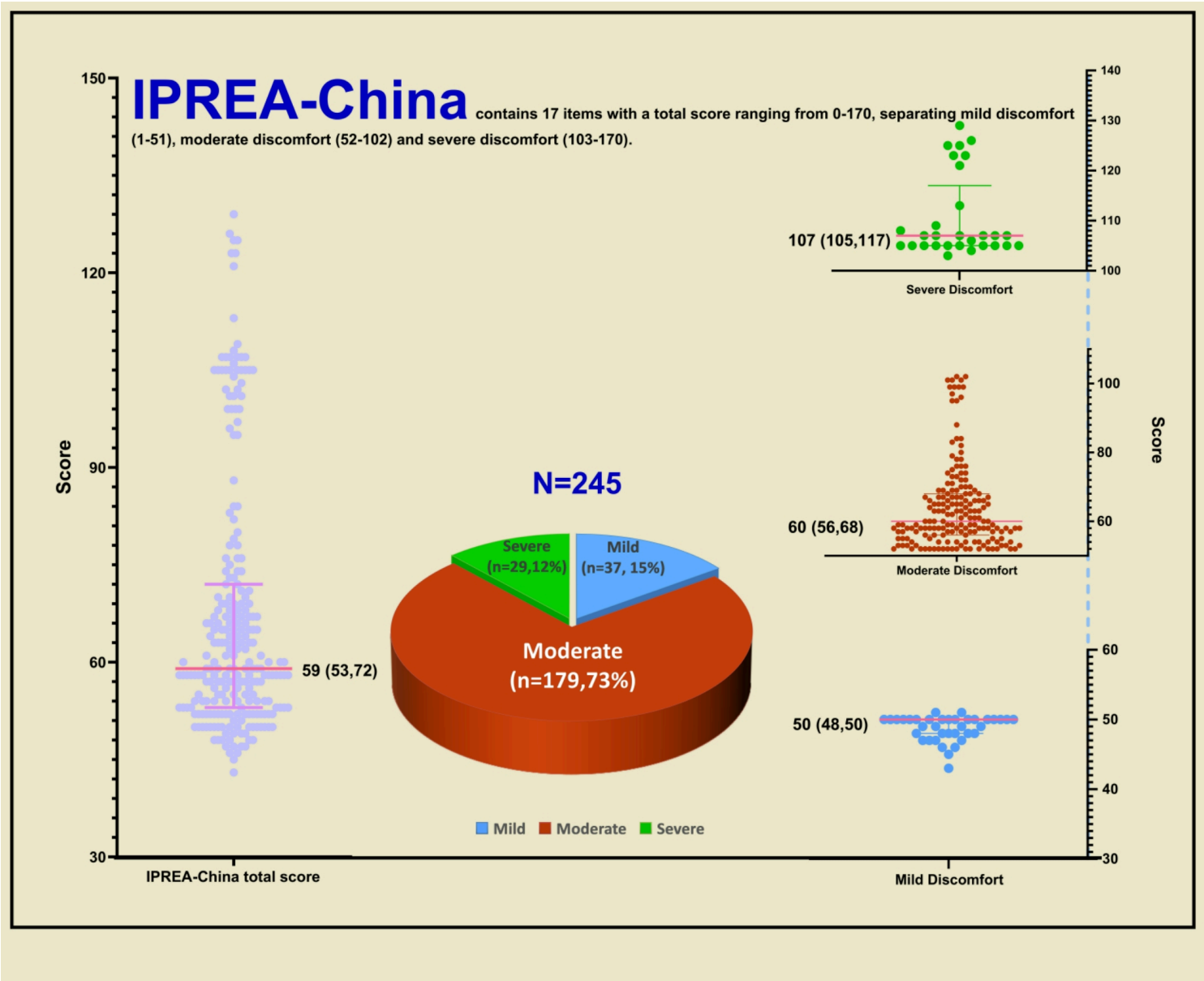


Figure 2

Overall Distribution of Discomfort in SAP Patients Assessed by IPREA-China

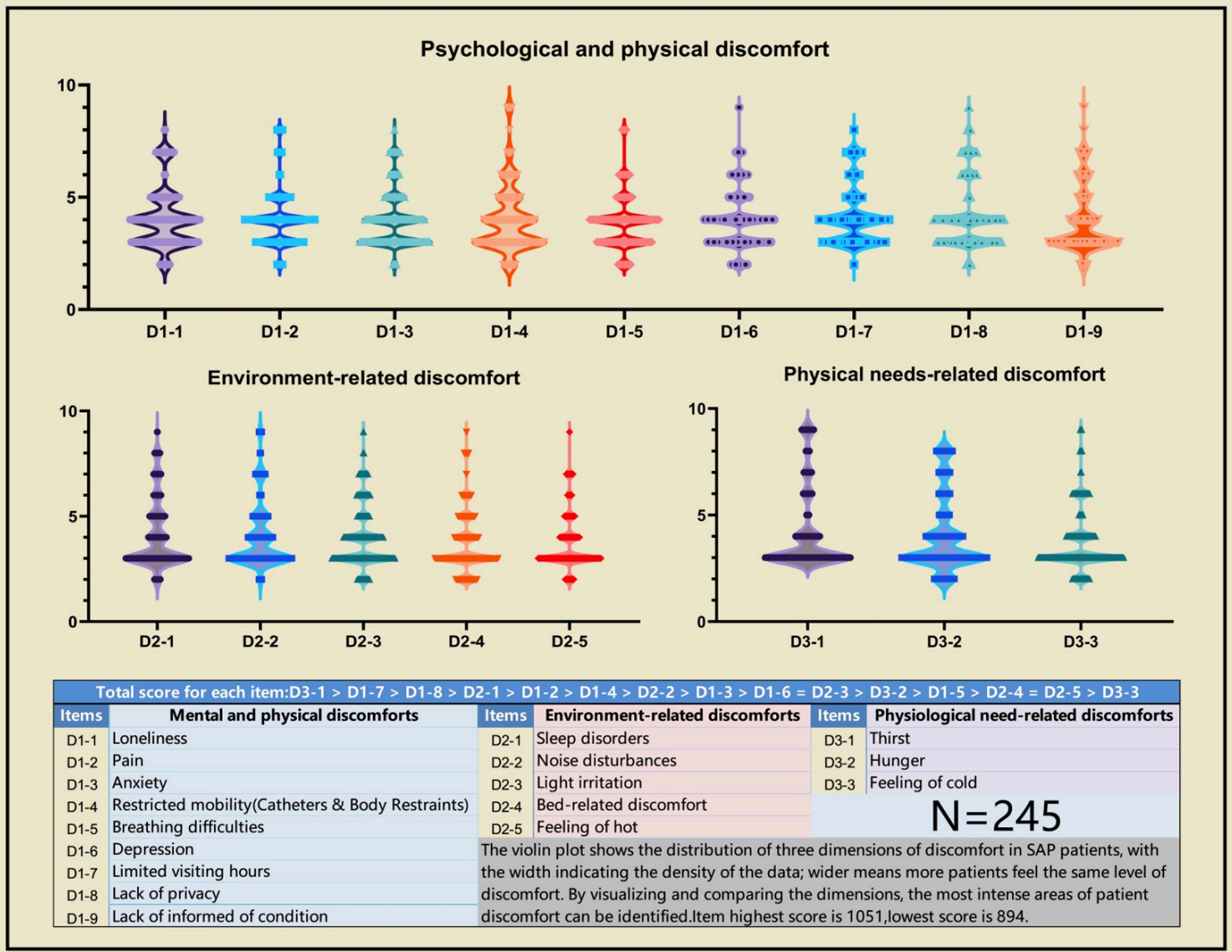


Figure 3

The Multi-Dimensional Distribution of Discomfort in SAP Patients: A Violin Plot